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STRATIFIED DISCHARGES IN VACUUM TUBES.

MR. GASSIOT'S EXPERIMENTS.

(With a Coloured Plate.)

The older electricians were familiar with the beautiful auroral effects obtained by transmitting frictional electricity through glass vessels partially exhausted of air. To obtain analogous effects with galvanic electricity a high degree of tension is required, which, until a few years since, could only be obtained by employing batteries containing an immense number of insulated cells. The introduction of coil machines enabled currents of great intensity to be obtained by the use of one or two galvanic cells; and when these machines were perfected by Ruhmkorff, very powerful effects were readily produced. The principle of a coil machine is that of accumulating the effects of a series of inductions. An intermitting current of galvanic electricity is passed through a thick copper wire wound round a bundle of iron wires, which in rapid alternations become and cease to be powerfully magnetic. Over this primary coil a great length of thin wire, covered by insulating materials, is arranged in close-fitting coils one over the other. In large instruments three or four miles of thin wire are disposed of in this way. In the centre of the thick primary coil the mass of soft iron becomes a magnet the moment the wire, is traversed by a current. When this takes place it attracts a little hammer of soft iron, so placed that as soon as it moved the current is interrupted. The effect of this interruption is that the mass of soft iron in the centre of the coil ceases to be magnetic, and the little hammer, ceasing to be attracted, returns, through the elasticity of its handle, to its former place. The current is then renewed, to be broken and renewed in very rapid alternations. At each renewal of the current through the primary coil, a fresh current, produced by induction, is thrown into the thin coils, and the greater the number of these coils, the greater the force of the electric discharge to be obtained from them.

The vacuum tubes, or vessels through which these discharges are passed, in order to obtain certain remarkable luminous effects, are of various shapes; in some cases the air in them is exhausted by making them form a part of a Torricellian vacuum, and then minute quantities of any gas required are introduced. In other cases such tubes are filled with carbonic acid gas, part of which is removed by means of an air-pump, and nearly all the remainder absorbed by caustic potash.

The atmospheric pressure inside one of Geissler's vacuum tubes is said not to exceed half a millimetre,* and is often much less. The general character of the discharge of a powerful induction coil through one of the vacuum tubes just described, is an alternation of luminous and dark bands, accompanied by a quivering motion.

When the discharge takes place through a tube containing an infinitesimal quantity of atmospheric air, the light of the positive pole is fiery red, that of the negative pole, violet. A hydrogen vacuum tube, in which bulbs alternate with capillary tubes, shows white light in the former, and red in the latter, dark bands alternating with light ones. Carbonic acid tubes give a greyish light, and nitrogen orange red. The dark bands or striæ vary in shape according to the nature of the so-called vacuum.†

Nothing can exceed the beauty of this class of experiment, and it is frequently heightened by the employment of tubes made of glass tinged with uranium, which becomes phosphorescent under the influence of the electric light. In one of the pieces of apparatus devised by Mr. Gassiot a stream of coloured fire falls into a series of different-coloured cups, while in another, a vacuum, tube is made to revolve, producing a wheel of splendid fire.

We are glad to observe that several opticians have recently produced coil machines and vacuum tubes on a small scale at a moderate price, so that this interesting branch of study has a chance of becoming popular, and those who cannot witness the magnificent exhibitions so often made at London soirées may be able to obtain at pleasure similar effects in their own homes.

Mr. Gassiot, to whom this and other branches of electrical science are under deep obligations, possesses a magnificent collection of vacuum tubes, amounting to more than four hundred, arranged in a convenient laboratory duly labelled, and their peculiarities registered in what we may designate an electrical ledger. Having tried innumerable experiments with the aid of Ruhmkorff's coils, Mr. Gassiot determined on the

* 760 millimetres correspond with 29,922 English inches of mercurial pressure.
† A real vacuum would not transmit the current at all.

construction of the most powerful constant battery yet made. For this purpose he caused four thousand cells containing carbon and amalgamated zinc elements, to be arranged on a series of trays, extending in his laboratory from the ceiling to the ground. These cells are excited by a solution of sulphate of mercury. Under the influence of the electric current, this solution is decomposed, the sulphuric acid attacking the zinc, forms a sulphate which remains in solution, and the mercury which is liberated gives the zinc a fresh coating of amalgam, and keeps down local action. The frames holding this magnificent apparatus are arranged at certain intervals, insulated wires are attached, and the number of cells set in motion by making connections at any point is made known by appropriate labels.

Before the currents from this battery reach the tubes, they pass through an apparatus by which they can be exposed to definite and measured quantities of resistance, in the shape of spaces of air and spaces of water.

We have prefaced a description of the remarkable experiments which the coloured plate prefixed to this article illustrates, and which is copied from a drawing kindly lent by Mr. Gassiot, by the preceding elementary remarks, because we believe that many persons not previously acquainted with this branch of investigation will take great interest in it, if assisted by the preliminary information thus afforded.

Amongst the large collection of vacuum tubes in Mr. Gassiot's collection, one made by Geissler yielded anomalous and most remarkable results. These, which were described by Mr. Gassiot to the British Association form the subject of our plate. When a discharge of from 1200 to 4000 cells of the constant battery is passed through this tube, after suffering a varying amount of resistance through the interposition of a column of water of different lengths, a series of striking effects are obtained. The resisting water column is contained in a glass tube half an inch in diameter and three feet long. At one end of this tube a wire is introduced, connected with one pole of the battery, and at the other end is a second wire, connected with the vacuum tube. When the discharge has to traverse the whole column of water before reaching the vacuum tube, a luminous appearance fills the latter without exhibiting any appearance of stratification. By depressing one wire in the water column, and thus reducing the resistance by shortening its acting length, small crescent-shaped discs of light are produced in quick succession, beginning at the positive pole, and alternating with dark bands. They speedily fill the whole length of the vacuum tube. A further depression of the conducting wire in

the water diminishes the resistance which the electric current experiences, and another change occurs in the vacuum tube. The discs commence receding, one by one disappearing at the positive terminal, until nineteen remain, much augmented in brilliancy and sharp distinction from the intervening dark bands. A still further depression of the wire, and diminution of the resistance, causes the two discs of light nearest to the negative pole to join together, and form a double convex pattern, the side facing the negative pole being a delicate blue colour, that facing the positive reddish fawn, with a brilliant red band between. A new crescent-shaped disc appears at the positive terminal simultaneously with these changes at the negative; and if the depression of the wire and diminution of resistance be further continued, the discs nearest the negative pole join in succession one after the other, a fresh crescent-shaped disc appearing each time at the positive end.

When the two wires in the water-tube touch, the resistance of that fluid ceases, and all the nineteen luminous discs assume the double convex form, and the colours, especially the blue, become exceedingly brilliant, (see Fig.), the double-shaped discs showing the discharges when the least resistance is introduced. When in this state Mr. Gassiot places the vacuum tube between the poles of a very powerful electric magnet, and immediately the discs separate, as if the water resistance had been again introduced, and they are deflected towards the upper or lower part of the tube, according to the direction of the magnetic current. On the sides of the tubes, where four or five of the discs nearest the negative impinge, there remains a black deposit similar to that deposited from the negative metallic wires of an induction coil. The negative pole is at the hammer-headed end of the figures, and the positive at the narrow end.

ON FISH CULTURE.

A VISIT TO THE PRINCIPAL PISCICULTURAL ESTABLISHMENTS IN GERMANY, SWITZERLAND, AND FRANCE.

BY AN OLD BUSHMAN.

I HARDLY think that in any country is the government more liberal, according to its means, than Sweden, in promoting scientific pursuits. Every year certain stipends are granted to various professors to enable them to travel in other countries for the purpose of obtaining information; and when they return to Sweden they have to publish a report in the *Transactions of the Academy of Science* of what they have seen. It is quite needless to dwell upon the benefits which are likely to accrue to a land like Sweden, one eighth of which is connected with water, and whose coasts are of so great extent, by adopting a proper management of the fisheries, and above all in paying a proper attention to fish culture. The following report by Professor C. Bystrom, who, in 1863, took a journey to Germany, Switzerland, and France, for the purpose of inspecting the different establishments in those countries for fish culture, will, I think, prove quite as interesting to the English as the Swedish reader.

Bystrom left Sweden on May 29th, and proceeded first to Frankfort-sur-Maine, and from thence to the little town of Herrenalh, near Schwarzwald, in Wurtemburg, to inspect the fish-hatching apparatus of Dr. Klenertz, which he describes as follows:—

The peculiarity in this hatching machine consists in this, that, unlike other apparatus for hatching the roe of the salmon, it does not let the same water pass over several layers of roe, through a row of boxes placed after or below each other, but each box has its own separate stream of water, which is as much as possible mixed with atmospheric air. Dr. Klenertz has found that when one and the same stream of water passes through several separate boxes, each of which contains one or two thousand roe-corns, the hatching out of the roe takes place later, or at least more irregularly, in the last box than in the first. The reason of this is, that when the living roe-corns, through a kind of breathing process, have consumed the oxygen from the water, it by degrees loses the necessary vitality which is required for hatching out the roe in the lower boxes. He has therefore invented the following hatching apparatus.

From the lower end of a spring the water is brought by a

short underground tube to a large stone trough, in which the trout are kept during the summer, until the roe and milt is ready for fructification in the autumn. The water runs from this stone trough through numerous separate pipes to two other large troughs, the one of stone, the other of wood, the sides and bottoms of which are covered with cement. Each of these troughs is about twelve feet long, two feet broad, and two feet deep. Small gratings are fixed into the sides, which serve as rests for the hatching boxes. These boxes are made of sheet iron, painted with oil colours, one foot square and five inches high on all sides, bored through with small holes in two rows. In the top of each box is a groove, likewise pierced with fine holes. After the box is filled with clean gravel to the height of three inches, on which the impregnated roe is laid, the water is turned on, which runs through a leaden spout, consisting of two pipes branching off from the main tube, and fastened to the troughs themselves with iron rods. From these pipes small perpendicular tubes, furnished at the ends with small filters, which separate the falling water, and bring it in contact as much as possible with the atmospheric air. Such a pipe carries the water separately into each of the hatching boxes, and the distribution of the water is further facilitated by the small holes in the tops of the boxes.

This method has led to the happiest results, and a very small percentage of the fructified roe is lost. The doctor also adopts a new plan for cleaning the gravel. To free this from the green slimy vegetation which often encircles stone, and would be most pernicious to the fructifying of the roe, he does not content himself with simply washing the gravel in cold water, but also in boiling water.

His mode of feeding the young fish during the first period after the umbilical bladder has disappeared is this:—He takes a quantity of well cleaned ox blood, and then several times every day pours a quantity of this into the lower end of the spring; this is washed down by the running water to the young fish, which have now a freer place of exercise in the boxes, as the gravel has been removed. As the young fish become stronger, he exchanges the blood for fine pea meal, which he gives to them in the same manner. At length he gives them different kinds of cheese for food. After the young fish are two or three months old he turns them into a river, which he has hired for six or eight English miles. When he hired this river, in 1857, the trout of which are noted for their fine flavour, the trout fishery in it had been so destroyed that the cleverest angler could scarcely catch one. Now, however, on account of the doctor's fish culture, the fishing

in this river has again become so good, that a good fisherman has no difficulty in killing ten brace of fine trout in a day.

In the beginning of July Bystrom left Herrenalh, and travelled to Bavaria. Here he met with a man, the State fisherman, who yearly hatches out, and also sends away, a great deal of the Danube salmon (*Sal. hucho*) to the large French establishment at Hüningen, and the manner in which he proceeds with the fructifying this roe, and sending it to Hüningen, is as follows :—

The fructifying vessel, which is tolerably large, and with a flat bottom, is filled about one inch deep with pure water, of the same temperature exactly as that in which the spawning fish live; then two persons take hold of a female fish, of which one holds the head, the other the tail. After the fish, which is held in an upright position, has ceased struggling, the roe, if it is quite ripe, begins to run from the fish; and in order to obtain as much as possible, the fish's sides and belly should be rubbed softly from the breast down to the anus. If the fish is large, it is never worth trying to press out all the roe at one time. If the fish is of a pound weight, or above, it is best at first only to take away part of the roe, and then slip the fish back again into the reservoir, that in a day or two after, when the rest of the roe is fully ripe, it may undergo a similar operation. After the roe has been pressed out, and spread over the bottom of the vessel, a male fish is taken, and a few drops of milt are pressed out into the water, and which, when they mix, have the appearance of thin whey. The roe and milt are then stirred up with the finger, and after five minutes the roe is packed in small boxes for sending away. These boxes are about two feet in length, six inches broad, and six inches high. On the bottom of the box a layer of damp moss is laid, upon this a damp linen cloth, upon this the roe is spread tolerably thin, and this is again covered with a wet linen cloth. The box is then filled with moss, so that the top presses pretty tightly upon it, and hinders the roe from shaking and rubbing during the transport. The transport from Augsburg by railroad to Hüningen is only a day; but if the roe is to be transported further, it is better not to pack them till the eyes of the fish appear like two black spots, because in this stage the roe is better fitted to bear the shaking during the passage. The roe thus sent to Hüningen usually hatched out seventy to eighty per cent. young fish. When it was necessary that the transport must take place through a warmer temperature, which always exercises a great influence on the roe, he had tried to keep the roe at a proper temperature by mixing ice with the moss in the boxes in which the roe was packed; but this had always failed, for the ice melted, and the

ice-water had injured the roe. If it is necessary to use ice, a double box must always be provided, and the ice packed in the space between the sides, so that it is altogether impossible that the roe can be injured by the ice-water.

From Augsburg he went to Munich, to inspect the hatching apparatus of J. B. Kuffer. This is constructed in a cold spring running out of a rock, near the banks of the river Isar. The spring conveys the water first through three large reservoirs, the one of stone, the two others of wood, each furnished with a sloping cover. On the plain below these, three smaller dams are dug, each about twelve to twenty feet square. The bottoms of these dams are covered with a layer of clay six inches thick, and over that another layer of fine clean gravel, and the sides are boarded. The water which runs through the before-mentioned reservoirs circulates between these dams, and fills them with water to the depth of about a foot. Around one of these dams is formed of boards a small canal, about six inches deep, and furnished with a cover. In this canal, the bottom of which is also covered with gravel, the roe is hatched, which does not, however, lie upon the gravel itself in the bottom of the canal, but in separate vessels of burnt clay. These vessels are round, scarcely a foot in diameter, and, as well as the covers, are perforated with small holes, and filled with a layer of fine gravel to the height of a few inches. The fructified roe is spread on this gravel, and the vessel is placed in the canal, so that the top part stands above the water, and the eggs lie in water one inch deep. On account of the fine holes in the sides of the vessel, the water has a gentle, but even motion, which imparts a lively current to the water in the canal.

In this manner the young of the great lake trout, of the charr (*S. lemanus*), and the huchen (*S. hucho*), are hatched only, as also of the common trout. As the water throughout the year has a temperature of 7° warmth Celsius, the young are hatched out in the short space of 43 days. The young fish during the first weeks of their lives, while they carry the umbilical bladder, must remain in the hatching vessel; but after this has disappeared, they require more room and food, and they are then turned into the canal itself, and fed on calf brains, mixed with wheat bran, in the form of little balls about the size of peas. To save trouble, the method of feeding the young fish is as follows:—

In the margin of a small wheel, about 8 or 9 inches in diameter, which by means of a common watch spring and the working of smaller wheels, is kept in an even and gentle motion, are a number of small holes or divisions, in each of which one or more of the beforenamed balls of meat are laid.

The balls are kept in their places by means of a tin shield fastened outside the wheel, till, on account of the rotary motion of the wheel they reach a small opening in the bottom of the shield, when they fall into a little strainer of iron or brass wire, which stands in the water below the wheel. The balls of food now soon dissolve, and the young fish eagerly snap up the small particles which become mixed with the water. Experience has proved that the young, at least of the salmon genus, are very unwilling to take their food after it has sunk to the bottom, and lies there motionless. It seems, therefore, necessary, in order to arouse their appetite, that the food, at least for a short time, should be kept floating in the water, and thus, on account of its motion, give it some appearance of life. For nothing but living food, such as small crustacea and the like, appear to be the natural food at first of the young *Salmonidæ*.

After Kuffer has fed the young fish for a few months, sometimes only for some weeks, he transplants them out into lakes and streams with excellent results. Some, however, are still kept and fed in the beforementioned reservoirs; and Bystrom saw in one of these, two lake trout, which in five years had reached a weight of between 8 and 9 lb. In one of these reservoirs he saw common trout of three years old, several hundred in number, which appeared to weigh from 2 to 3 lb. In another, about 1000 trout of two years old, which were about 8 to 10 inches long, and in another, several three years old "Laiblinge" (*S. lembla*) of about 1 lb. weight. All these are fed with small living fish of the carp genus, such as *C. jeses* and *C. nasus*, which are taken for this purpose in the river Isar, as well as the entrails of other fish. In order to attain a quick growth, these salmon trout and charr require a considerable quantity of animal food, and no one but a man like Kuffer, who has it in his power to procure a sufficiency of food, can carry on this. But as he hires a great deal of water from Government, at a very moderate outlay, to encourage his fish culture, he never has any want of food throughout the year.

As all the salmon are naturally fond of shady places, where they can lie in wait for their food, Kuffer has constructed a little place of shelter along one side of the feeding-dam, of about three feet long, and furnished at the bottom with a small opening, through which the fish can enter. Here they retire when alarmed by any passing shadow, and lie hid, and when they venture out again for food, which is cast before the opening of their retreat, they take it with the speed of lightning, and the eye can scarcely detect the glance of a fish before it has again retreated to its hiding place.

In the tract around Munich are also several other breeding places on a smaller scale, but all upon the same plan as that of Kuffer.

Even in Kreuth, not far from the Tyrol border, a Dr. Stephens had constructed an apparatus for hatching out the young fish, which had been attended with good results. But he had also constructed several large dams for the purpose of fattening useful fish for the table. But this was not successful. These fish, which consisted principally of Rhine salmon (from roe furnished by the Society at Hüningen, in France), *Salmo lembla*, and common trout, had already attained an age of seven years, and yet the largest did not weigh more than about 2 lb., whereas the fish in Kuffer's reservoirs in Meinchen, at the age of three years, weighed about 3 lb. This proves how ill such fish culture pays without proper attention and proper food. The food at Kreuth consisted of flesh offal from the kitchen, and was given irregularly, and was probably not palatable to the fish.

After Bystrom passed the principal part of August in Lindau, Constance, and Langenay, all on the Lake of Constance, he set to work to procure some fish from this lake for the Society in Sweden; and when he heard that in the Canton of Zurich, in Switzerland, there was an excellent establishment for fish culture, he proceeded to the little town of Meilchen, on the Lake Zurich, where this establishment lay. This has been about ten years in operation, and belongs to one Jacob Frieman, and is built at a little distance from the town, by the side of a small stream, which runs from some cold springs in the vicinity, and then flows down the vine-covered mountains which surround the town. On a small plain at the foot of a steep hill one sees some large and smaller dams, and in the midst of them a neat little rustic cottage, which serves as a receptacle for the fish-hatching apparatus, and contains a museum of fish preserved in spirits; under this house, and extending for some distance beyond it, are three small parallel canals, each about one foot deep. Fed by water from the running brook, these canals form the principal hatching receptacles for the fish; but as the temperature of the water in the winter is altogether too low, and as the water is sometimes frozen up so that the hatching is delayed, it was necessary to seek the nearest springs in the vicinity, in order to form new canals, in which to hatch the roe, close to them. These canals are boxes, 12 to 16 feet long, 9 inches broad, the bottom covered with gravel, and the further ends furnished with a fine wire grating. By each of the two springs, which are situated a short distance from each other, three such boxes were placed close together, but each a little below the other, so that the water, with a little fall, could

freely circulate from one to the other. For the rest, the three boxes were placed on the free but sloping surface of the ground, only with the upper end a little sunk in, to keep out the snow, and protect the roe from water mice and other enemies; each box was furnished with a locked cover.

Here they do not use, as in Bavaria, small separate vessels for hatching out the roe. The roe corns are spread on the gravel in the bottom of the canals, and the water is kept at such a height that it just covers the roe, which is laid in two layers.

They only hatch out salmon and trout roe, and the method employed is exactly as we have before described. But they have found out here, by experiment, that the milt of the male fish can be over-ripe, and in this state it is very thin, and will scarcely mix with the water or colour it white. Such milt is altogether useless for fructification; and as soon as the before-mentioned signs appear they must procure other milt which is fitting, and which in appearance resembles tolerably thick cream, easily mixes with the water, and gives it an even whitish colour. It is not necessary to use much milt to fructify good roe; the water should be only slightly coloured. It is of great consequence that, after the milt is mixed with the roe, by stirring it up with a fine hair pencil, the water for at least a minute should be shut off, and new water poured in; for it is highly pernicious to the roe to let it be five or ten minutes in contact with the wet milt. Only in a case where the roe shall be immediately carried for a short distance can it remain in the water impregnated with the milt; but in case of a longer transport it should be immediately packed in damp moss.

As soon as ever the young fish have lost the umbilical vessel, Freiman thought was the best time to implant them into their natural water. To keep them longer in confined tanks, fed on an artificial diet, he fancied served for nothing else but to obliterate their natural instinct, and unqualify them to live in free water. This artificial feeding up of a great many young fish is always attended with a considerable loss; besides, the danger which the young salmon incur when they are planted out, is not, after all, so very great. They live, generally, more isolated than other fish, and have a great instinct to hide themselves from their enemies; besides, the larger fish of prey do not willingly follow a single young fry, but principally attack those little fish which swim in shoals. During the last few years, Freiman had planted out into Lake Zurich several thousands young fish, principally sea, lake, and brook trout, as well as charr, both *S. salvelinus* and *S. lemanus*. In consequence of the great size of the lake, no visible increase of fish

can yet be perceived; but in the smaller streams, in which the young fish had also been planted out, the result after five years had been proved to be very satisfactory.

Several hundreds of the young fish were also kept and fed in the dams. For the least, which were about half a year old, they had constructed a small open channel, with fresh running water from a cold spring. This channel has a winding course, with here and there small basins of a circular form, and is about four feet long and six inches deep. In each of these small basins, which are divided from each other by fine gratings of brass wire, young fish of different species are kept, and all appeared to thrive well in this clear cold water. To shield the young fish from the rays of the burning sun, these basins were covered with light screens of basket-work; and to keep out water rats, etc., a small hedge of willows set in the ground, and about a foot high, with willow branches interwoven, was formed on each side of the little channel round these basins.

The food in use was the raw flesh of white fish, pounded fine with a hammer, which was cast into, and greedily devoured by the shoals of the small fish. Freiman thought that the flesh of fish was better suited as food for these small fish than other flesh, or even blood. So long as the fine crushed food is kept in motion in the water, which is easily done by stirring it with the hand, it forms a great attraction for these small fish. In the beginning the food is given them once every day, but after that only once a week. Kept upon this, as it seems, simple enough diet, the young fish have always a fresh appetite, and the water is not rendered foul through a mass of rotten rubbish, which can not be prevented when a large mass of other food is used.

After many unfortunate trials, in larger and deeper basins, to bring up the new-born fish, the best results were hit upon by these small shallow basins, through which the cold clear spring water keeps up a continual and even current. In deeper dams the current is too strong, and the cleansing of the water does not take place quick enough. But at about two years old the young fish may be put into larger and deeper dams; for they now require more room, and can tolerate a depth of water of two feet. In two larger dams, about thirty feet long and five feet deep, they keep more valuable fish, such as the three and four year old trout and *S. lembla*, as well as some seven year old trout. Both these dams, fed with water from the brook itself, are, like all the smaller basins, covered on the bottom with a layer of muddy earth, over which is spread a thinner layer of gravel. Grass grows freely on the bottoms; but the dams are cleaned out every spring and autumn. Even these dams are shaded by tops of basket-work

laid over their smaller ends. There is also another dam in conjunction with these, of the same size, which has no gravel on the bottom; but the grass is allowed to grow freely, for this dam is set apart for the fish that are used as food for the trout —all of the carp genus. These fish breed naturally in this dam, and their progeny are generally full grown at the age of four years, when they will weigh about ½ lb. The seven year old trout, of about 3 lb. weight, fat and handsome, are, like the younger trout, fed only once or twice in the week; but they devour a great quantity at each meal; and as the fish which are produced in the abovementioned dam cannot furnish sufficient food, the principal part of the food for the older fish is procured from the Lake Zurich.

The cost of the whole apparatus was about 3000 francs; and the yearly expenses, exclusive of the salary to the governor, about 700 or 800 francs.

(*To be continued.*)

NOTES ON FUNGI.—No. V.

BY THE REV. M. J. BERKELEY, M.A., F.L.S.

FERRUGINOUS-SPORED AGARICS.

(*With a Tinted Plate.*)

Some of the finest of our British Agarics belong to this series, but, with one or two exceptions only, to be mentioned presently, it scarcely contains an esculent species, and certainly none of any great importance. We have already seen that amongst the white-spored Agarics one or two exceptional species occur in which the spores are slightly tinted. In the present series we must take the term ferruginous in a wide sense, and refer to it species in which they are clay-coloured, yellowish, or of a decided brown. These latter have sometimes been considered as forming a distinct series, *Phæospori*, but for the present at least they are included by Fries amongst the *Dermini* which form the subject of the present notice.

The subgenera belonging to the series are *Pholiota*, *Hebeloma*, *Inocybe*, *Flammula*, *Naucoria*, *Galera*, and *Crepidotus*, which are so distinct that there is little danger of their being confounded, if common attention is paid to the differential characters. Some latitude, however, must be given to the colour of spores, though in one or two subgenera a peculiar tint may be prevalent.

The first subgenus, *Pholiota* (from φολὶς, a scale), is distinguished by the presence of a perfect ring (a character rather artificial than natural), and is analogous to *Armillaria* amongst the white-spored Agarics, both on this account and because the hymenophorum is not distinct from the stem. It is easily divisible into three sections characterized by their place of growth—the first consisting of those species which grow on the ground; the second of those which are strictly inhabitants of decayed wood or decaying trunks of trees: species with brown or ferruginous spores occur in either section; the third contains two species which grow on moss.

In the first section our indigenous species are but few. *Agaricus arrhenii*, Fr. (Fig. 1), is a pretty species of rare occurrence, which we have detected in one of the curious, abrupt, and unexpected dells in Nottinghamshire, which are known by the vernacular name of "Dumbles," and abound in rare and curious species. This is not, however, attractive, like many of this subgenus, for size or sculpture, but rather for elegance of form. *A. præcox*, P. (Fig. 2), which, together with the closely-allied *A. durus* and *sphaleromorphus*, belongs to this section, is one of the first to greet us on lawns and banks in the spring, after the first heavy rains of April, when the esculent white-spored *A. gambosus* forms circles in our fields. The species is always attractive, not only on this account, but because of the ample ring which is marked with lines in consequence of the deposit of the spores and the white stringy mycelium. *A. durus*, a closely-allied autumnal species, is known by its spores having a decided ferruginous tint.

In the second section we have numerous representatives, and certainly some of the most handsome and striking species in the genus.

In the first division of this section we have species with brownish olivaceous or clay-coloured, but not brightly ferruginous, gills. *A. radicosus* is striking for its size and spotted pileus, but more especially for its deeply-rooting stem, in which respect, though not in others, it resembles *A. radicatus*. *A. pudicus*, Bull (Fig. 3), occurs now and then on stumps of trees, especially elder, and Mr. Cooke has discovered one or two closely-allied species, which, like *A. pudicus* and some others of the section, do not extend far northwards. Some of these are esculent, and one of them is well known and highly valued in Naples, under the name of Piopparello. It is called Pioppino in Tuscany, but is not held in such high repute.

Our more common species, *A. pudicus*, never occurs in sufficient abundance to make it an object of any importance, though, it is probable not unwholesome. Passing from these, *A. aurivellus* and *squarrosus*, with the numerous forms of the

latter, are often very striking, and especially *A. squarrosus*, which sometimes occurs in large picturesque groups at the base of ash trees, of whose speedy decay it is unfortunately too sure an indication. The rich colour, densely scaly pileus and stem, and beautiful form, render it a very striking object.

When, however, we come to the species with tawny or purely ferruginous gills, we have still more striking objects. *A. spectabilis*, formerly known as *A. aureus*, when well grown, is of the richest golden tawny, and as remarkable for size as tint, while *A. adiposus*, which affects the trunks of old beech-trees has a pileus which resembles in sculpture and colour the fruit of the richest pine apple. *A. flammans* is figured in its young state in our coloured plate which appeared with No. IV. of these notices, and is confined to the wood of Conifers.

In the section with cinnamon-coloured gills, which are not yellow in an early stage of development, we have *A. mutabilis* and *marginatus*, the former of which, as the name implies, is extremely small. The former is sometimes eaten abroad under the name of Stockschwamm, a name which more properly belongs to *A. melleus*, which is equally detestable. A little group still remains, not in the least allied to the other species, consisting of but two species, which would, but for their ring, be inserted amongst the *Galeræ*, to be described hereafter. *A. pumilus*, belonging to the third section, is a pretty little Agaric, and not uncommon on moss in lawn.

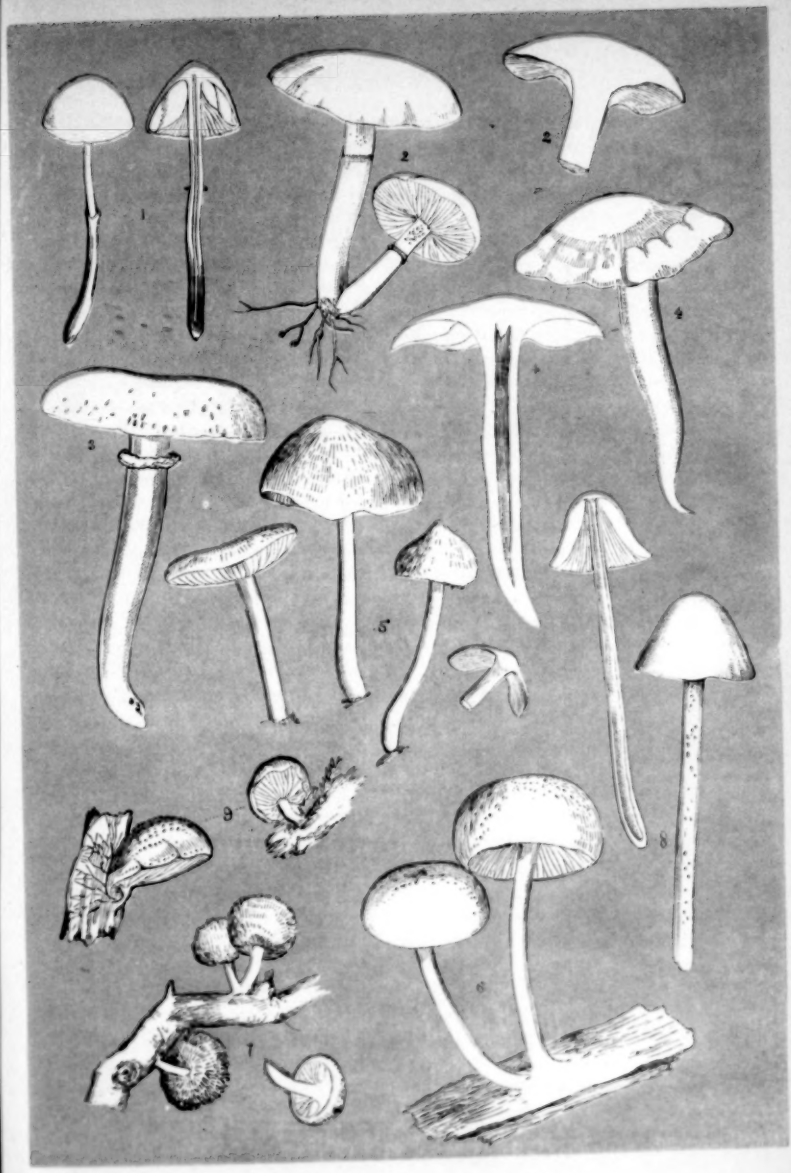
Hebeloma (from ἥβη, down; and λῶμα, a fringe), corresponds with *Tricholoma* in the want of a distinct ring, in the fleshy pileus, and the gills being situated behind. All the species grow on the ground, and were for the most part originally combined under *A. fastibilis*. Some of the species, however, have not the peculiar odour which distinguishes the nearer allies of *A. fastibilis*, resembling that of the flowers of *Cerasus lauro-cerasus*. Most of them, but not all, are destitute of a veil. Some of them, especially *A. crustuliniformis*, form enormous rings in woods, and occur in the utmost profusion; and many so closely resemble each other in outward form and colouring that their determination is difficult, and the species in general may be set down as amongst the least interesting, especially as there is not one of them which is esculent. We have chosen as our illustration *A. versipellis* (Fig. 4).

Inocybe (from ἶς, a fibre; and κύβη, a head), was formerly joined with *Hebeloma*, but the habit is so different that it has very properly been separated by Fries. While the *Hebelomata* have a smooth, moist, or somewhat viscid pileus, clothed with a distinct pellicle, and a veil, if present, distinct from the pellicle, the species of *Inocybe* have the coat of the pileus silky or fibrillose, and the veil, if present, continuous with the

coat. In the former the spores are mostly clay-coloured, in the latter brown. They all grow on the ground, and abound in woods, being mostly rather early fungi. As in the former case, they do not comprise a single esculent species. They are divided into sections according to the nature of the clothing of the pileus. The first section contains those which have the pileus covered with rough squarrose scales from the first, and a scaly stem of the same colour. The species are rare in this country. The species of the second section have the pileus scaly, or torn into loose fibrils, while the stem is paler and fibrillose. Amongst these, *A. pyriodorus* is the most remarkable, having a scent like that of decaying pears. *A. obscurus* reminds us of some of the blue-stemmed *Hyporhodii* by the violet tint on the stem. *A. flocculosus*, Berk. (Fig. 5), affords an illustration of this section. The species are not always easily distinguished, but in this and the following section there is a character in the spores of some species to which Fries has not adverted. In general they are quite even, but in other cases they are rough with granules, but not irregular in outline as in so many *Hyporhodii*. In the third section, which is distinguished by the pileus being longitudinally rimose, we have one of our commonest Agarics (*A. rimosus*), which occurs everywhere. Finally, there is a section with a smooth disc, but a silky, or, more rarely, a scaly pileus, and a smooth white stem, which is farinaceous above. *A. geophyllus* is one of our commonest woodland species, very variable in colour, and sometimes prettily tinted with violet or lilac. *A. vatricosus*, which I have found in Wales, generally grows about the trunks of trees, and looks like a viscid *Armillaria* when young.

Our next subgenus is *Flammula* (from *flammula*, a little flame), a name indicative of the prevailing colour. It contains many beautiful species, but poorly represented in this country. Indeed, till I met with *A. sapineus*, Fr. (Fig. 6), in Aberdeenshire, there was scarcely a certain representative of its most beautiful section. They are known by the carnoso-fibrous stem, the fleshy pileus, and the acutely adnate or decurrent gills. In most of the species the spores are of a bright tint, inclining more or less to tawny.

In the first section the cuticle of the pileus is inseparable and fibrillose. In the second the pileus is viscid when moist, and the pellicle more or less separable. To this section belongs *A. lentus*, which is easily known from one or two analogous British species by its viscid pileus. The third section has not a separable cuticle, though the pileus is moist in wet weather. *A. flavidus* is our most abundant species, resembling in colour *A. fasciculari*s, but distinguished at once by purely ferruginous spores. The veil adheres in patches to the margin, and some-



FERRUGINOUS SPORED AGARICS.

1. Agaricus Arrhenii, Fr. ½ nat. size.
2. —— praecox, F. ½ nat. size.
3. —— pudicus, Bull. ½ nat. size.
4. —— versipellis, Fr. ½ nat. size.
5. —— flocculosus, Berk. Nat. size.
6. Agaricus sapineus, Fr. Nat. size.
7. —— crinaceus, Fr. Nat. size.
8. —— apalus, Fr. ½ nat. size.
9. —— depluens, Batsch. Nat. size.

times, though rarely, forms a ring. In the fourth section the pileus is neither pelliculose nor viscid, and is broken up more or less into scales and fibrils. The species are often very beautiful, and *A. sapineus*, which occurs on trunks, chips, and sawdust in Scotland, is certainly one of our most beautiful fungi, though few are more variable.

Naucoria (from *nauci*, of little value) comprises various species agreeing in the cartilaginous stem, ferruginous spores, and the margin of the pileus being at first incurved. Some of the species are very beautiful, but the most beautiful have not at present occurred in this country, though some of our indigenous kinds are very interesting. In the first section, which has a smooth pileus and truly ferruginous spores, one of the most remarkable is *A. cucumis*, which has a peculiar odour, which is thought by some to resemble that of the cucumber, while others think that it is like that of some fish, and has in consequence been called *A. pisciodorus*. *A. horizontalis* also is an interesting species, from its swarming occasionally over the bark of living trees, after the fashion of the white-spored *A. corticola*. In these species the gills are broad, and only slightly adhered. *A. melinoides*, on the contrary, which belongs to the same section, and is one of our commonest species on close-shaved lawns, has truly adnate gills.

The second section has brownish spores, like some of the *Pholiotæ*. The more common species somewhat resemble in colour the smooth *Hebelomata*, and amongst them, one of the most generally diffused is *A. semiorbicularis*, which occurs everywhere in pastures.

The third section has a flocculent or squamulose pileus, with a definite veil. Here again we have more ferruginous spores. *A. furfuraceus* is perhaps the most common of Agarics, occurring at all seasons, and almost defying frost and snow. It assumes multitudinous forms, but under all is known by the pileus growing pallid when dry. A few have the pileus innato-squamulose, and are amongst the most interesting species, *A. erinaceus* (Fig. 7), which grows on fallen twigs, is always a welcome object, from its beauty and comparative rarity, and there are other interesting natives. Nor must we omit *A. carpophilus*, a little species which occurs on beech mast, and has the pileus rough with shining atoms, and distant, broad, ventricose, nearly free gills.

Galera (from *galera*, a conical hat), is an extremely natural group, characterized by ochraceo-ferruginous spores, and the straight margin of the more or less campanulate pileus, and is strictly analogous to *Mycena* amongst the white-spored, and *Nolanea* amongst the rose-spored Agarics.

The species of the first section, with a viscid pileus, are

represented in this country by a single species, *A. reticulatus*, which is, however, extremely pretty, though small, and analogous to *A. phlebophorus* amongst the *Hyporhodii*.*

In the second section the gills ascend in the more or less conical pileus. Of these the very common *A. tener* is the best representative, as it is not only typical, but is found everywhere. *A. apalus*, Fr. (Fig. 8), is a rare native.

In a third section the gills are horizontal, and *A. hypnorum* in its various forms, whether on green mosses or sphagna, is to be found in all districts. On sphagnum it sometimes acquires a considerable development. The spores of all are pretty objects under the microscope, from the purity of their colour and their regular outline.

There remains only *Crepidotus* (from κρηπίς, a shoe), which, like *Pleurotus*, is distinguished by its eccentric pileus, which in extreme cases becomes resupinate in consequence of the complete obliteration of the rudimentary stem. Very rarely the pileus from the first is cup-shaped, and the hymenium superior. Two or three of the species have pink spores, as *A. depluens*, Batsch (Fig. 9), and *variabilis*, and ought certainly to be associated with the *Hyporhodii*. They grow either on decayed wood, twigs, etc., or on moss. *A. depluens* occurs sometimes with a distinct, almost central stem. I am not aware whether any species has been found with purple-black spores, so as to have more evident relations with the next series.

Figures 1, 4, and 8 are copied from drawings sent to me by Fries.

* *A. aleuriatus* has lately occurred in Northamptonshire.

DETONATING METEORS OF FEBRUARY AND NOVEMBER.

BY A. S. HERSCHEL, B.A.

It is probably very seldom that a large meteor passes over the islands of Great Britain without some particular notice of the occurrence being made in one or other of the many public journals, which separately and collectively chronicle the passing events of every large town in the United Kingdom. It is, however, seldom that the accounts can be collected. It is yet more seldom that a regular channel is opened to the details that private persons are often well able to furnish, but which, from principles of sufficient or insufficient reason, they either deem it unnecessary to record, or think them better left to professional observers to supply. It is thus that a meteor of the largest size, on the 21st of November, 1865, shot directly over London, which was probably disregarded by many, who would ere now have consigned it to oblivion, if these few remarks should not have the good fortune to recall the fact of its occurrence to their memory.

Among the published accounts of the fireball of the 21st of November last was a description of the meteor by Mr. Warren De la Rue, as it appeared to him near Cranford. The attention drawn by so great a name as that of the late President of the Royal Astronomical Society to the circumstance, was the cause that several private accounts of the meteor were received by Mr. Warren De la Rue from observers in all parts, to whom prompt acknowledgments were returned for the interesting details which they describe. I have selected from the documents the following particulars. A comparison together of the accounts, at the same time, permits the real altitude, position, and velocity of the meteor to be determined, at least approximately, within small limits of error.

The height of the meteor, at its first appearance, is determined from six independent accounts, each of which was separately compared with Mr. Warren De la Rue's original observation of the meteor at Cranford for the point of first appearance. The average error of the separate accounts is seven British statute miles above or below the true mean height, which is the mean of all the separate heights, and is taken as the height at first appearance. The height at disappearance is determined in a similar manner, from the same six accounts, compared with the apparent place of disappearance of the meteor as observed at Wimbledon by Mr. F. C. Penrose. The average error in this case is, as in the former case, about seven miles

above or below the true mean height at disappearance. When the nature of the phenomenon is considered, and particularly the difficulty of fixing the exact position of the apparent path of the meteor by the several observers, it is not surprising that occasional differences should exist in the resulting heights, but rather wonderful that such good observations could be made. The real altitude of the meteor at the moment of disappearance was somewhat greater than that of a detonating fireball (presently to be mentioned), on the 11th of February, 1850, investigated by Mr. Glaisher, which disappeared at a height of nineteen miles above Biggleswade, in Bedfordshire.

The meteor of the 21st of November, 1865, traversed the entire length of the valley of the Thames, a distance of about seventy-five miles, from about forty-one miles above the Nore to a point about twenty-seven miles above the earth's surface, in the neighbourhood of Henley-upon-Thames. On the average of four separate accounts, varying between four and ten seconds, the time taken by the meteor to travel the entire distance of about seventy-five miles was six seconds and a-half. On this estimate, the velocity of the meteor relatively to the earth's surface was about eleven miles per second; and the direction of its flight appears to have been from a part of the heavens in the neighbourhood of the constellation *Taurus*, situated between *Taurus* and the head of *Cetus*.

The distance of the meteor at the moment of its disappearance from Wimbledon, as determined by the accounts, was about thirty-six miles. At Wimbledon Mr. Penrose heard a loud report, like that of a cannon fired off at the distance of some miles, distinct enough to be heard very plainly by more than one person at Wimbledon, about two minutes and twenty seconds after the meteor had disappeared. Sound, with its ordinary velocity of 1090 feet per second in common air, would take two minutes and fifty-four seconds to travel the above distance, determined by the accounts, from the point of disappearance of the meteor to Wimbledon. Considering, as before, the difficulty of fixing the exact position of the apparent path of the meteor by the observers, and the very approximate nature of the real path concluded from their statements, the agreement of the calculated time with the time observed by Mr. Penrose between the disappearance of the meteor and the occurrence of the sound must be regarded as extremely close. There can be very little doubt, from Mr. Penrose's description, and from the near approach of the fireball to the earth (twenty-seven miles), as well as from its large size, and small velocity, that the meteor was in reality a fireball of the detonating class.

Detonating meteors are described in the *British Association*

Reports as having been observed in England very nearly on the same date of the year as that of the 21st of November last. The first exploded over Norwich, with a very loud report, on the 19th of November, 1861 ; the second occurred on the 20th November, 1864. Of this the explosion was heard at Hallaton, in Rutlandshire, like the noise of distant artillery, lasting several seconds. Finally, a detonating meteor of unusual size, attended by a very violent report, described by Kepler, a description afterwards repeated by Halley in the *Philosophical Transactions* for the year 1719 (p. 978), which happened in Germany on the 17th of November, 1623 (N.S.), may be further thought, with a certain probability, to belong to the same zone of meteors encompassing the sun. As the length of the sidereal year exceeds that of the tropical year by just one day in seventy years, the date of Kepler's meteor (nearly two centuries and a-half ago) would coincide with the place of the earth in its orbit at the present time, on the 21st of November—exactly the date when Mr. Warren De la Rue's meteor was observed.

The apparent coincidence of dates in such rare phenomena as detonating fireballs is exemplified by at least one other remarkable instance, which deserves to be recorded. A brilliant detonating fireball was observed by Brydone on the 10th of February, 1772, as described by himself in the *Philosophical Transactions* for the following year. The meteor was followed by a startling report, at an interval of at least four minutes after it had disappeared. An equally brilliant detonating meteor was seen from the Royal Observatory, Greenwich, by the present Astronomer Royal, Mr. Airy, on the 11th of February, 1850. It was ascertained by Mr. Glaisher that this meteor, to which allusion was already made above, as one of the best-investigated examples, exploded at a height of nineteen miles above Biggleswade, in Bedfordshire. The report was heard in Oxfordshire, and in the neighbouring counties round, like a clap of thunder. Finally, an exceedingly large detonating meteor, of which full accounts appeared in the local papers at the time of its occurrence, appeared last year at Bangalore, in Southern India, with a report like a hundred cannons, on the evening of the 9th of February, 1865.

The 9—11th of February, and the 19—21st of November, are dates deserving future study, with the special view of determining the direction of the detonating meteors. At present the frequent return of detonating meteors on those dates plainly indicate the fact that these bodies, like the acknowledged star-showers of August and November, revolve in fixed orbits round the sun.

NOTES ON OUR COMMON INDIAN BIRDS.*

BY R. C. BEAVAN, LIEUT.,

Bengal Revenue Survey.

Although in India we are not enlivened by the melodious whistling of the thrush, the cawing of rooks, or the pleasing song and sprightly ways of our old friend the robin, yet there are many birds around us which attract our notice every hour of the day, and which, although if not so dear to us from old associations, as are the birds of England, are nevertheless equally capable of being petted and domesticated, and of the greatest interest to all who take a delight in the ways of the feathered creation.

Even the well-remembered sparrow, inhabitant as he appears to be in England of a somewhat cold climate, for which he seems peculiarly fitted, is here found, if not represented, by actually the same species—by one† so near to it, in everything except size (and the difference in that is but slight), that most observers could not, without actual comparison, distinguish between the two. Whilst this species here occupies the plains only, in the hills it is replaced by another English bird, the mountain or tree-sparrow, *Passer montanus*, Linn., which is the common species in the Himalayas, building there under roofs of verandahs and houses. Although the robin has no representative here of his own immediate kin, which, like him, is seen continually associated with man, yet in his place we have the mynas, a group of birds belonging to the starling family, of which two species, the common brown myna, *Acridotheres tristis*, Linn., and the pied starling, *Sturnopastor contra*, Linn., are so extremely common in Lower Bengal, that hardly a tree can be passed which does not harbour some, or a few minutes spent near one's door without several being seen. Like the thrushes, they seek nearly all their food on the ground; which, however, instead of worms and snails, consists of grasshoppers and crickets, the staple insect food of birds in India. Another peculiarity, too, which one observes between them and the thrushes is, that whereas the latter *hop*, the mynas, as a rule, *walk*, only giving an occasional hop when they are in a hurry. The scientific name, *Acridotheres*, given to the genus, and derivable from ακρις, "a grasshopper," and θηρα, "a hunt," describes accurately its habits, for it is essentially a "grass-

* The birds treated of in this paper are the commoner ones, found in the neighbourhood of Calcutta.

† *P. indicus*, Jard. and Selby.

hopper-hunter," and indeed feeds on little else. A pair of them (*A. tristis*) may be seen gravely walking near each other on the grass, their heads moving back at every step with a peculiarly graceful motion, and putting up the grasshoppers in front of them, as a sportsman would walk up birds in a turnip field, but with the difference that the myna seldom fails to bag his victim, which is seized as it rises by a quick forward motion.

The brown myna is a favourite cage-bird with the natives, soon becoming tame and familiar, and is much prized for its powers of talking and mimicry. Though it cannot be said to have a song, its notes are very cheerful and pleasing; and often, too, it attempts a kind of whistling strain, but the effort is not continuously kept up.

Jerdon says of it*—"It is one of the commonest birds in the country, affecting towns, villages, and the neighbourhood of man, rather than the jungles;" and describes it as "a household bird, breeding almost exclusively in nooks and eaves of houses, under the roofs, in holes in walls, or in pots hung out for that purpose by the natives." It displays no fear in taking up its abode in these earthenware pots, and does not seem to be at all aware that by nesting in them, it devotes its young to a life of caged captivity.

This species has a much wider distribution over the country than its congener, the pied starling, whose range is limited. I believe that the locality of the nest is the only sure test in cases of doubt between the eggs of these two species, since I have never found the pied starling to build, except in trees. The eggs of both are exactly alike in all respects, of a pale blue colour, similar to those of the English starling.

The pied starling has much the same habits as the brown myna, and is equally common, but it seems to be rather more gregarious, and several pairs will build near each other in the same tree, constructing large domed nests of loose-looking materials, in the most conspicuous places.

The common kite of India, *Milvus govinda* (Sykes), deserves special notice, as being so abundant everywhere, and contributing in no small degree by the immediate removal, in conjunction with the crows, of every scrap of offal, to the prevention of the noisome diseases liable to arise from a tainted atmosphere in a tropical climate.

Near Calcutta, and other large towns, the kite cannot be termed a bird of prey, since he lives entirely on garbage; but away in the jungles, where he is also found sparingly, he has no doubt to resort to the original prey of the *raptores*. The great scavengers amongst birds in India are, of course, the vultures,

* Jerdon's *Birds of India*, vol. ii. part i. p. 325.

but they do not condescend to come down from aloft to anything smaller than a carcase, but leave the odds and ends to the kites and crows, who clear up everything, and by numbers fully make up for what they lack in size. The vast numbers and fearlessness of the kites are among the first objects that strike the stranger from England, where birds of prey are so rare. And, to quote Jerdon again*—"When a basket of refuse or offal is thrown out into the streets to be carted away, the kites of the immediate neighbourhood, who appear to be quite cognizant of the usual time at which this is done, are all on the look-out, and dash down on it impetuously, some of them seizing the most tempting morsels by a rapid swoop, others deliberately sitting down on the heaps along with crows and dogs, and selecting their scraps. On such an occasion, too, there is many a struggle to retain a larger fragment than usual, for the possessor no sooner emerges from its swoop, than several empty-clawed spectators instantly pursue it eagerly, till the owner finds the chase too hot, and drops the bone of contention, which is generally picked up long before it reaches the ground, again and again to change owners, and perhaps finally revert to its original proprietor. On such occasions there is a considerable amount of squealing going on." This cry is a prolonged tremulous squeal, *more felino*, and gives the native name of "Cheel" to the bird. These birds are partially migratory, for Blyth has noticed that a large number leave Calcutta for some months during the rains.

Of all birds, whether English or Indian, in point of cunning, acuteness, and general intelligence, our crow, *Corvus splendens* (Viellot), the grey-necked crow of some, in my opinion, surpasses all. Omnivorous in his diet, he knows, as well as you do, the exact hour for meals, and, truly living on the crumbs that fall from your table, he is patiently waiting on a tree outside your door, until he sees the first dish go in, when he gives a peculiar caw as a signal, and on its return from the table there are at least twenty eager visitors awaiting its reappearance, where, five minutes before, but a solitary bird was to be seen. When the fragments are thrown out from the cook-house, ever on the alert, with one eye on the cook, and the other on the coveted morsel, down pounces our crow, and hopping up, generally sideways, when he sees the coast is quite clear, suddenly seizes a fragment, and is off with it to the neighbouring tree. His example is speedily followed by the rest, but all observe extreme caution in their approaches, until the whole of the booty having been disposed of, they either visit your next door neighbour who happens to breakfast a little later than you do, or if in the afternoon, about four

* *Birds of India*, vol. i. p. 105.

o'clock, betake themselves in company to the nearest tank, and thoroughly enjoy the luxury of a bath.

These birds must rank very near the jackdaws, I should think, forming, perhaps, an intermediate link between them and the true carrion crows, of which latter our Indian representative, *C. culminatus*, is tolerably plentiful everywhere, generally in twos or threes.

The common crow, *C. splendens*, is one of the most difficult birds there are to entrap, or take in in any way; they appear up to every gesture and movement, and are so suspicious, that one would naturally suppose that their generation had habitually been subjected to severe persecution. But such is far from being the case; no one ever thinks of molesting them, since they are so extremely useful in a sanitary capacity. Their great abundance in every station in the country is a proof of the protection they receive. Birds get in India less persecution from the human race than perhaps in most other countries not similarly constituted. The majority of the population being Hindoos, have an aversion to taking life, and the Mohammedans will not eat anything that has not had its throat cut *whilst alive;* so that their chances of getting a dinner with a gun would be but small.

I need only give one more instance of the sharpness of the common crow. Being in want of some as specimens, I made a bargain with a man to shoot me forty, for which he was to be remunerated at the high rate of four annas (sixpence) a-piece. The first fifteen or so were procured in a few days, then a long interval elapsed, and no more were forthcoming, until at last the man in despair came and said he was very sorry, but that he really could not get near another bird. He had been out nearly the whole of that day trying to stalk them, and although they were very plentiful, they would not, do what he would, allow him to come within shot, and yet just beyond the range of his gun, they would come down and eat the rice thrown out, as if nothing were the matter.

To conclude, I take the following extract from Jerdon*:—"So well known is the process of cooking, that a small fire, or rather its attendant smoke even, in some unusual spot, far away from their daily haunt, will at once attract one or two hungry crows, who, if the symptoms of food are favourable, remain for the expected leavings. In the intervals between the meals of mankind, some betake themselves, early in the morning, to some plain that has perhaps been flooded, to pick up a crab, frog, fish, or insect; others hunt for grubs in ploughed lands, or in pastures, along with cattle; and others may be seen ridding cattle of the ticks, or other insects that

* *Birds of India*, vol. ii. part i. p. 299.

infest them; some betake themselves to the side of a river or tank; a few in the vicinity of larger rivers, or creeks, follow vessels, and hunt with the gulls and terns; and not a few about Calcutta, and other large cities, find a plentiful repast on the corpse of some dead Hindoo, or on that of a dead bullock. . . . . They generally build in trees, making a moderate fabric of sticks, occasionally thinly lined with some soft materials. An instance is recorded by Mr. Blyth where a pair of crows in Calcutta had built their nest of the wires taken off from soda-water bottles, which must have been purloined from some native slop-seller. The eggs are usually four in number, of a greenish blue, spotted and blotched in various degrees with brown."

The next commonest of our permanent residents are the king crows, or drougo shrikes, which are not represented in England by anything nearer than the true shrikes, and which Jerdon truly calls "a most characteristic feature of Indian ornithology, for go where you will you are sure to see one or more of the genus."* The common species is *Dicrurus macrocercus* (Viellot), better known by the name of the king crow, from his habit of pursuing crows and kites, at all seasons more or less, but with increased vigour in nesting time. He is a handsome bird, about the size of the English blackbird, and of the same colour, but with a long tail; and like other fly-catchers, lives entirely on insect food, of which white ants in their winged state form not a small portion.

It generally perches in some commanding position, whence it can get a good look-out all round, and on perceiving an insect will dart down at it, and then return to its post. Among other spots, it seems to like sitting on the backs of cattle, which, as they move, disturb the grasshoppers, which the king crow soon picks up. Jerdon says it generally seizes its insect prey on the ground, or whips one off a stalk of grain, frequently catching one in the air; but I have never heard an instance of its impaling insects on thorns as done by other shrikes.

Mr. Phillips relates a curious instance of sagacity, or reasoning, in this bird. Another bird was pursuing a large locust which the king crow coveted, but apparently did not dare to seize, when he suddenly uttered his cry of alarm, betokening the presence of some bird of prey; the original pursuer of the insect quitted the chase, and the king crow carried off the locust as his lawful booty.†

(*To be continued.*)

* *Birds of India*, vol. i. p. 426.

† *Ibid*, vol. i. p. 429.

THE NEWTON STONE.*

A REMARK upon this stone we made under the head of "Archæologia," in our January number, brought us first an expostulatory letter from Dr. Moore, the author of the book of which we give the title below, and subsequently a copy of the book for review. We gladly take the opportunity of explaining a little more fully the real character of a monument which has given rise to such singular vagaries among learned men.

Archæologists are well acquainted with a class of inscribed stones which are found scattered through the Celtic districts of England. They are sepulchral monuments, which have been usually placed in the position of upright pillars, and bear inscriptions in Latin, commemorative of the personage, no doubt a man of some importance, whose place of burial they were intended to mark. They range probably from the fifth or sixth to about the eighth century, *after Christ*, or perhaps somewhat later. These stones are most abundant in Wales, or perhaps we ought to say, that in that part of the island more of them have been preserved, and they have been more carefully looked up. Many have been described and explained in the volumes of the *Archæologia Cambrensis*, by the experienced pens of Professor Westwood and the Rev. H. Longueville Jones, to whose papers on the subject we can recommend our readers for further information. They are found in Cornwall precisely similar in character to those found in Wales, and at least one example will be found in the *Archæologia Cambrensis*, just referred to. They are found also in Scotland, for no one acquainted with the subject can doubt that the Newton Stone belongs to this class.

The inscription, as we have already stated, is in Latin, and is usually brief, giving the name of the deceased and of his father, and sometimes of some other relative, and in one or two instances describing his condition or dignity, and it has usually at beginning or end the formula, HIC IACIT, instead of *hic jacet*—the men acquainted with letters at that time having apparently confounded *jaceo* with *jacio*. Another remarkable peculiarity of these monuments is, that many of them bear a secondary inscription along the edge of the stone, in what are called Ogham characters, which, when it has been interpreted, is found to be merely a repetition of the Latin inscription, with the names given often in their more purely Celtic form. Now, there are strong reasons

* *Ancient Pillar Stones of Scotland: their Significance and Bearing on Ethnology.* By George Moore, M.D., M.R.C.P. Lond., etc. 8vo. Edinburgh: Edmonstone and Douglas.

for believing that the Ogham characters themselves are not of very remote antiquity. They do not belong to what is properly called an alphabet, but to a system of cypher; and they are not letters, but arbitrary symbols to represent letters. In the earlier centuries of the mediæval Church in the West such cyphers were favourite exercises of monkish ingenuity, and rather numerous and very various systems are found in mediæval manuscripts. The Oghams were very probably invented by the early Celtic monks, and originated, perhaps, in Ireland, which would explain how they would be communicated to Wales, Scotland, and Cornwall, the early ecclesiastics of which were in close intercourse with the Irish Church. In this respect, it is a significant fact that the inscription on the Newton Stone is accompanied with an Ogham inscription arranged along the edge exactly in the same manner as on the inscribed stones in Wales. For comparison we may refer to the examples engraved in the *Archæologia Cambrensis*, third series, vols. i. p. 8; vi. pp. 134, 225, 314; vii. pp. 43, 138; viii. pp. 54, 137.

The Latin inscription, especially in the shorter and perhaps the earlier ones, is sometimes written in bold Roman letters, only a little debased, and it is then easy, or, at least, not difficult, to read. The letters, however, though still Roman, are often very debased in character, a mixture of capitals and minuscles, and sometimes rather fanciful forms, some of them made from the Roman ligated letters, which render them very difficult to decipher. One of the Welsh examples Professor Westwood himself was unable to read (*Archæologia Cambrensis*, third series, vol. ix. p. 258). As might be expected, the population of Scotland was probably at this time far more illiterate than that of Wales, or that of Cornwall—pictorial art was more in accordance with the popular taste than letters*—and hence we have the Roman characters ruder and more debased, and it would no doubt take a considerable amount of careful study to arrive at the correct reading of the inscription on the Newton Stone. The difficulty in reading these inscriptions is increased by the circumstance that they contain early forms of Celtic names with which we are not well acquainted. Among the Welsh inscriptions, however, we can already see traces of the forms which appear in the Newton inscription; see, for example, in the *Archæologia Cambrensis*, the inscriptions in vol. vi. pp. 224 and 225, and vol. viii. p. 220.

* We feel satisfied that no sound and experienced archæologist can look over the plates of Stuart's *Sculptured Stones of Scotland* without being convinced that they *all* belong to the Christian period. The forms which occur without any direct indication of their date—as, for instance, on the Logie Stone—are all found elsewhere on monumental crosses. Dr. Moore, instead of accepting the obvious inference that the figures themselves were made by Christians, considers this to be a proof that the early Christians of Scotland were tainted with Buddhism.

It is this difficulty in reading the Newton inscription, combined with an entire want of knowledge of the class of monuments to which it belongs, which has furnished some imaginative philologists with the ground for some rather extraordinary theories. First, as far as we know, came the late Dr. Mill, the well-known Sanscrit scholar, who read it backwards, and found out that it was Phœnician. According to Dr. Mill's elaborate explanation, this stone commemorated, if we remember right, the escape from shipwreck of a high magistrate of the city of Tyre, while on a voyage to the north of Scotland. This interpretation was read in section E, at the meeting of the British Association in Cambridge, in 1862, on which occasion a cast of the stone was exhibited, as well as a copy of the inscription made for Dr. Mill's essay. A few archæologists, acquainted with similar Welsh and Cornish monuments, who were present, recognized the true character of the Newton Stone at once, and it was shown that it was written in debased Roman characters. It is easy, indeed, to see that the first letters have been lost by a chipping of the stone. These letters no doubt were HIC, and a following I, and the first limb of an A, what now remains being the second limb of the A, and the letters C, I, T. The whole was originally HIC IACIT, exactly the form of the latter word which is found in the other inscriptions on this class of monuments. The second line, as it stands at present, is clearly meant for CONSTANTINVS or CONSTANTIVS, probably the former. This was rather a favourite name among the Celtic population of Britain after the Roman period, from the circumstance that the Roman emperors of this name were looked upon as especially connected with our island, and that the mass of the coinage then in circulation was that of the Constantine family or imitations of it. The rest of the inscription is very difficult to decipher, but in the fourth line we seem to trace tolerably satisfactorily the word FILIVS, and the fifth line ends with an I, which appears to be the termination of a proper name in the genitive case, perhaps the name of the father of Constantinus.

To judge by the photograph given by Dr. Moore, the inscription appears to have been tampered with since the cast was exhibited at Cambridge, and thus rendered more difficult; by the expression "tampered with" we mean that somebody, to render it possible to take the letters more perfect by the process of photography, appears to have painted them white. Everybody knows how difficult it is to obtain a satisfactory photograph of such an inscription, when, as in the present case, the surface of the stone, through length of time, has been much corroded, and the outlines of the letters are not always very distinct. It will be seen at once

that the outlines of letters painted under such circumstances must be those of the painter, and not those of the stone.

Dr. Moore rejects the interpretation of Dr. Mill, and employs the volume before us to develope a new interpretation of his own, on the assumption that the language in which it is written is what he terms "Arian"; and his theory is, as we understand it, that at that remote period, when the whole Arian family was still only one people located in a spot in Central Asia, where it spoke the primæval Arian language, from which all the modern languages of the different branches of this family are derived, Arian missionaries made their way across the continents of Asia and Europe to plant in the north of Scotland this monument of pure Buddhism, which they are supposed to have established there. Dr. Mill's theory of the Tyrian magistrate visiting Scotland, though not probable, is perhaps just within the limits of possibility, but we can hardly say the same of the story of Buddhist missionaries making the still longer journey overland! The Arian is an assumed and not a known language; and in the way in which Dr. Moore manufactures it by a mixture of words taken from Sanscrit and other tongues, known and unknown, we may make any sort of a language, to which we may give any name we like. It is too much like that old exploded style of philological investigation, which was so cleverly ridiculed by Swift, when he showed that the English was the primitive tongue, by resolving Alexander the Great into All-eggs-under-the-grate, Archimedes into Hark-ye-maids, and the like. We believe that ten men like Dr. Mill and Dr. Moore might make ten different languages to interpretate in as many different ways the inscription of the Newton Stone, and all equally be satisfactorily. Whatever the Arian language was, it has taken many vast nations of people many centuries under the influence of organic laws to produce the various known derivatives from it; and does Dr. Moore think that one man in a small portion of his life could reconstruct the unknown primitive language out of its remote derivatives, so as to apply it with accuracy to a short inscription like this? It is more than our belief that the language of Dr. Moore's reading of the Newton Stone is one which never existed, and we are sorry to be obliged to regard his book, however ingenious, as only another monument of mistaken ingenuity and industry. T. W.

RAMBLES IN CORNWALL FOR MINERALS AND FERNS.

BY BERNARD HENRY WOODWARD.

How are you going to spend your holidays? Do you wish to see fine scenery, to make sketches, to collect geological or botanical specimens, or are you an antiquary?

For to a lover of any one or all of these pursuits a trip to "West Barbary" will give him his heart's desire. Nor need you cross the sea to visit this *terra incognita*, for it is the land from which our heir-apparent derives his greatest revenue—in fact, it is the appellation given to the Duchy of Cornwall by the inhabitants of the lovely sister county of Devonshire.

A kind invitation from an excellent Cornishman (Mr. Talling), a resident of Lostwithiel, determined us to make that place our head-quarters for a few days, and of all the localities we visited, none had greater attractions; for the surrounding country in whichever direction you go, is extremely beautiful. Situated about a mile to the north, on a high hill, stands the venerable castle of Restormel, which we visited on the first day. It was built before the time of William the Conqueror, but is now in ruins, and the walls are completely enveloped in ivy. On the road, which runs along between the hills and the river Fowey, we found the "male fern," *Lastrea filix-mas*; the "broad fern," *L. dilatata*; the "lady fern," *Athyrium filix-fœmina*; the "hard fern," *Blechnum boreale* or *spicant*; and the "hart's tongue," *Scolopendrium vulgare*. The latter was growing luxuriantly in the damp castle dungeons, while on the walls were the "common maiden hair," *Asplenium trichomanes*; and the Polypody, *Polypodium vulgare*. In the Bath woods on the opposite side of the river, which is here crossed by a rustic bridge, we found the "royal fern," *Osmunda regalis*; and the *L. dilatata*, and *A. filix-fœmina*, both more than five feet high, and the *Blechnum*, with the fertile fronds over two feet. On our way back, we followed the footpath along the top of the hills. From the Terres Hill there is a charming view, the quiet little town (or "city," as the inhabitants designate it) of Lostwithiel lies below, with the river Fowey wending its tortuous way through the marshes till it is hidden among the hills in the distance. In the lane leading down from Terres Hill, the "black spleenwort" is met with, *Asplenium adiantum-nigrum*, and the "soft prickly shield-fern," *Polystichum angulare*.

In the Poldue Wood about half a mile west of the town, the *Osmunda* occurs in great abundance, and the *L. filix-mas*,

with fronds six feet high and fourteen inches broad. A bank at the top of the wood was covered with the "hay-scented fern," *L. fœnisecii* or *recurva*, growing very luxuriantly, being about two feet high, while the average size of the frond is scarcely more than eight inches.

At Par, a small village on the sea-coast, about five miles to the south, are the "Par" and "Fowey Consols" copper and tin mines, where *Francolite*, a variety of apatite (phosphate of lime), and also good crystals of pyrites are found. A walk on the sands disclosed the "sea spleenwort," *Asplenium marinum*, in great abundance in the caves and fissures which occur all along the cliffs, here composed of the "killas" or clay slate (of Devonian age). In some of these caves a little removed from the sea, the *A. adiantum-nigrum* and the *Scolopendrium* were unusually large.

Along the road to the east of Lostwithiel the hedges abound with small plants of the *L. fœnisecii*, and also the "heath" or "mountain fern," *L. oreopteris*. The rich golden hue of the latter fern renders it a very conspicuous object. The fronds when bruised yield a peculiar, but not unpleasant odour, which induced Linnæus to name it *Polypodium fragrans*. In an osiery at Polscoe, we saw an immense quantity of *Osmunda*, which towered above our heads. About three miles farther in the same direction is the old house of Boconnoe, which was occupied by Charles I. as his head-quarters in September, 1644.

One of the most pleasant days of our Cornish ramble was spent on the river Fowey (pronounced *Foy*). The distance from Lostwithiel to the town of Fowey, at the mouth of the river of the same name, is about five miles as the crow flies, but is much farther by water. After meandering for the first mile and a half through the marshes, the river winds for the remaining distance between high hills, which for the most part are covered with oakwoods to the water's edge; and the broad stream assumes the appearance of a lake, when the frequent bends close in the view both in front and behind. Just after leaving the marshes there is a good view of the Milltown viaduct by which the railway crosses a small branch of the river Fowey. The Cornwall Railway, only sixty miles in length, passes over five miles of viaducts, and under seven tunnels. These viaducts are all composed of stone pillars for about half their height, and the other half of a wooden framework bolted together with iron rods. They are mostly very lofty, that of Combe Lake (lake is "Cornish" for a small stream or brook), being 120 feet, and one at St. Austell 156 feet high, while one near Liskeard and another at Truro are remarkable for their length. A striking echo, which will repeat two or three

words with great clearness, haunts this part of the stream below Milltown. Half way on the left bank is St. Winnow's Church which contains some good original stained glass in the windows. Next we come to Penquite, the seat of Colonel Peard (better known as "Garibaldi's Englishman"), on the right bank; situated on the top of a hill, and just opposite to the branch of the river which runs up to Lerrin; it commands a most magnificent view. We then passed Gollant, Penpol Creek, Bodinnock, etc., and arrived at our destination. Between Polruan on the left and Fowey on the right bank, the river is very wide, and forms a commodious harbour.

By following the Restormel Road, the Fowey may be traced in the opposite direction towards its source. About half a mile from the town is the adit-level of the Royal Iron-mine of Restormel, the ore is the hydrated peroxide of iron (*hæmatite*): it is here that the fine specimens of "Limonite," or wood-iron, and the most perfect crystals of Göthite, both hydrated peroxides of iron, are found.

A little farther on, under the castle, there is a small quarry in the killas where it is of a pale blue-grey colour, easily broken, and with good cleavage planes, while at the Terres Hill, scarcely three-quarters of a mile distant, where the killas is altered ("alterated" a Cornishman would say) through contact with the granite, it is extremely hard and tough, has little or no cleavage, and is contorted and twisted in the most remarkable manner. At the Terres Hill it is quarried for road-metal, for which it forms a most excellent material; axinite in good crystals is found here.

For breaking the Cornish rocks it is necessary to have a hammer made of the best steel. Mine was made by a native blacksmith, who, being accustomed to make hammers for the stone-breakers, knew the right temper.

On the bank of the road between Restormel and Lanhydrock we met with the "prickly-shield fern," *Polystichum lobatum*, in addition to the other ferns found before.

The river Fowey rises at Fowey Well to the east of Brown Willy, on Bodmin Moor, and is not navigable until it arrives at Lostwithiel, having meandered for twenty-four miles, though the distance is only half that in a straight line. After leaving the moor, its course lies through luxuriantly-wooded valleys, abounding in ferns, the lady-fern in particular being very fine.

In the neighbourhood of Lanhydrock, the banks were covered with the *Oreopteris*, almost to the exclusion of everything else. Coming to Glyn, near the Bodmin Road station, the seat of Lord Vivian, we walked through the grounds, and saw the "brittle-bladder fern," *Cystopteris fragilis*; the

"toothed bladder-fern," *C. dentata;* the "beech fern," *Polypodium phegopteris;* and the "oak-fern," *P. dryopteris*, which we did not meet elsewhere in Cornwall. At Wheal Jane, a lead-mine, we obtained some specimens of "cerusite," or carbonate of lead.

One evening we walked over to the Helmen Tor, on Red Moor, which rises to the height of 700 feet above the sea level. This hill is about half a mile in length, and is strewed, as is the whole surface of the moor, with immense blocks of granite (whence the Cornish name of that rock—Moorstone), which had been worked in some places where they happened to be near the road, and a block could easily be cut out. On the tor the huge masses were piled in the wildest confusion, some of them overhanging so much that they looked in the distance as though a slight push would send them over the precipices. There are several "logan" or "rocking stones" on this tor. One block measures 13 ft. long, 10 ft. wide, and 4 ft. deep, and therefore weighs upwards of 30 tons, but is so nicely poised that it "logs" with the slightest pressure; even the wind moves it. From the summit of this hill, on a clear day, both the English and Bristol Channels, and the lofty tors of Dartmoor can be distinctly seen.

Another day we visited the dyke of porphyry, from which the stone was obtained for the Duke of Wellington's sarcophagus in St. Paul's Cathedral. It occurs near Luxulion, also on Red Moor, but about three miles south of the Helmen Tor, and four east of Lostwithiel. Pisani, the French chemist, describes it as a porphyritic granite, in which the mica is replaced by much tourmaline, which is in radiating needles of a very dark green colour, and in which are embedded crystals of flesh-coloured orthoclase felspar, with a very little quartz. He has given it the name of *Luxuliane*, after the locality where it is found.

From the Treffry viaduct—which also serves for an aqueduct, which is continued along the east side of the valley of Carmiers—we had a splendid view of the beautiful valley, having on our left the hills, which were well wooded, overhanging us, and on our right the valley, at a depth of from 200 to 300 feet; in some parts the side was quite precipitous, while in others the slope was more gradual. A small stream flowed along the bottom, and in one place there was a little waterfall over the precipice, of which we could not see much, being directly over it. Immense masses of granite here and there towered far above the trees, while ferns were growing everywhere.

Walking on through Prideaux, we found a fine specimen of crystallized schorl, a black variety of tourmaline, which had been

built into a wall, but which we carried off, as we could see that the natives did not appreciate it. And then on through St. Blazey to Par, where we took the train back to Lostwithiel.

In the evening we went to St. Winnow, and on the banks of the road we found *Polystichum angulare* and *P. aculeatum* in great abundance; the latter we had not met with before.

One day we took the first train to St. Austell. Its church is built of the celebrated Pentuan stone, which is a hard and very tough, pale cream-coloured "elvan." This stone takes its name from Pentuan, a small village on the sea-coast, five miles to the south, where it is quarried. It is a fine-grained rock, composed of felspar and quartz, and very durable. We found the road from St. Austell to Pentuan, which runs down a valley by the side of a small stream, two inches deep in the fine china clay dust, which was extremely disagreeable.

This elvan dyke first appears about a mile to the north of Pentuan, then runs half a mile S.W. to Polruddon, where it turns inland, and can be traced as far as Little Ventonwin, a distance of five miles. It can be seen well for the half mile along the cliffs in the killas; it varies in breadth from eight to twenty feet. From the top of the cliffs a fine sea-view may be obtained across Mevagissey Bay, with its bold coast-line to the south, and to the north the Black Head, a mass of greenstone, and beyond that St. Austell and Tywardreath (pronounced Tordreth) Bays, and then the Gribbin Head, behind which lay the town of Fowey.

St. Austell derives its importance from its tin and copper mines (one of the most famous of which is Polgooth), and the tin-streaming,* and large china clay works in its neighbourhood.

The china clay or kaolin, a hydrous silicate of alumina, results from the decomposition of the felspar in the granite, which may have been produced by the infiltration of waters containing carbonic acid in solution; the effect of which would be to carry off the potash, etc., in the form of carbonates or silicates in solution. Orthoclase felspar commonly constitutes about 45 per cent. of granite. It is the large-grained granite that is most prone to decompose. The rock of the extensive moor between St. Austell and the Hensbarrow Beacon (1054 feet high) is of this description, and is worked wherever there is a sufficient supply of water; for the kaolin is separated from the quartz and other impurities by washing with water in a series of tanks, the light particles of the china clay being carried forward into the lower reservoirs, while the heavier materials settle. It is then dried, cut into square blocks, and sent

* A large proportion of tin is obtained in Cornwall by the stream-works from the alluvial deposits, which are analogous to the "gold-washings."

to Charlestown or Pentuan, to be shipped to the potteries, and sometimes even to China.

Among the mines we visited was the "Silver Vein Mine," in which there is an excessive amount of water. The present engine raises rather more than 20 gallons a stroke, at 16 strokes per minute, which is equal to 466,560 gallons per day; but that does not enable them to work lower than 50 fathoms, the lowest level at present. A new engine was in course of erection which will pump upwards of 68 gallons per stroke. At 10 strokes a minute, this will amount to 989,280 gallons in the twenty-four hours.

This mine, which is situated on a hill about half a mile to the east of Lostwithiel, is one of the most interesting in the duchy, on account of the occurrence of the only lode of fahlerz, or argentiferous grey copper ore, near the surface in Cornwall. The fahlerz contains a good percentage of silver—about 35 oz. of pure silver to the ton—whence the name "Silver Vein." The "gossan" also contains a considerable, though varying, quantity of silver, being worth from £3 to £40 per ton. Gossans are generally of no intrinsic value, but only as indications of the contents of the lode. This is an iron gossan, but of a pale colour, owing to the iodide (?) of silver* disseminated through it. Very minute quantities of fahlerz also occur in it. The change from gossan to fahlerz takes place at about thirty fathoms depth, and continues as such throughout the length and depth of the mine, as far as it now extends. The vein varies in width from a few inches to a few feet (three feet being about the average), but this is not all ore, some parts being much richer than others.

Before going underground we had each to change our own for a suit of miner's clothes and boots, but no socks, and a very strong and heavy broad-brimmed wide-awake, so that if a piece of rock fell on our heads it might not kill us. We then repaired to the shaft, where we were each presented with a tallow candle, stuck into a soft lump of clay instead of a candlestick. We lit it, and then fastened it to the front of our hats with the soft clay. We descended the mine by means of ladders, as is the case in nearly all the Cornish mines, the shaft not being perpendicular, as in coal mines, where the depth and extent of the deposit is pretty well known, but having to follow the course of the vein, which cannot be told till it is actually seen. In this all the ladders except the third were nearly perpendicular, but that one sloped at a considerable angle. At every ten fathoms levels are driven, and through all of these we went, Captain Burn kindly directing our attention to the points of

* Silver more frequently occurs as chloride.

interest. It was pleasantly cool underground, the water, which was over the tops of our boots in some parts of the levels, being quite cold. This mine was excellently ventilated.

We next visited Chiverton Moor, and walked on past Perranzabuloe and Perran's Well, towards the ruins of St. Perran's Church, which is half buried in the sands through the encroachment of the sea; but being overtaken by darkness before reaching it, we turned round and proceeded more than a mile over the sands towards Porth Towan, on our way to St. Agnes. Small hills of killas rise here and there on the sands, and we passed the ruined engine-houses of two deserted mines. Immense numbers of rabbits were running about. We then followed the road, which was extremely hilly, to St. Agnes, passing numerous mines both at work and deserted. The country in this neighbourhood is burrowed like a gigantic warren, and after dusk, or indeed at any time, it is necessary to use the utmost caution, for the old shafts are scarcely ever walled in nor protected in any way.

Coming to St. Agnes Beacon, a hill 621 feet high, we found it nearly encircled by some remarkable beds of sands and clays, at an elevation of about 300 to 400 feet, which have been worked for tin-stone, numerous small veins of which exist in the granite that crops out just below on the western side. We then went down to Chapel Porth, passing Huel Coates, where fine pseudomorphs of cassiterite (oxide of tin), after twin crystals of orthoclase felspar, occur. In a bank close by we found a piece of rock containing cavities that had been occupied by crystals of orthoclase.

On the way from Portreath to Pool we were stopped by two Cornishmen, who inquired what we "carried"—*i.e.*, sold; for tourists are scarce in this part, and they had never seen any but pedlars carrying knapsacks before.

Pool is the centre of a large mining district, being midway between Redruth and Camborne, and just below Carn Brea Hill (735 feet high), which is granite, though Pool is on the killas. We visited the celebrated mines of Dolcoath, Cook's Kitchen, and Tin Croft. They are worked for tin and copper, though at one time a considerable quantity of silver was obtained at the first-mentioned mine. At Tin Croft I picked up a nice specimen of crystallized "chalybite" (carbonate of iron) on a crystal of quartz. At Cook's Kitchen we saw a peculiar blue rock, which the miners considered "good for tin"—that is, a good indication of the neighbourhood of tin-ore, not that it was ore itself.

At Carn Brea mine we obtained a large collection of granite from underground, the specimens differing either in colour or size of grain. Thence on to East Pool, a tin-mine, in which

occurs a great quantity of wolfram (tungstate of iron), which was at first mistaken for tin-stone by the adventurers. It has very little commercial value, as there is scarcely any demand for it, being only employed in this country in making the tungstate of soda, used to render ladies' dresses incombustible, in giving hardness to plaster of Paris, and as a mordant in dyeing. Some years ago it was worth from £8 to £9 per ton, but is not now of half that value. In Austria it is used for hardening steel, and at one time some was exported there from Cornwall for that purpose. Steel alloyed with tungsten is said to be much harder than that prepared in any other way, but unfortunately very difficult to temper.

One day we took the rail to Liskeard, and then walked through the town, which lies on a hill about a mile to the north of the railway station, along a road over a seemingly endless series of hills, each one apparently higher than one before, on to the Cheese-wring on Bodmin Moor. The "Cheese-wring," or "press," though it may have been used in Druidical worship, is evidently a natural formation. It consists of a pile, thirty-two feet in height, of gigantic rocks, the four uppermost overhanging the lower stones. From its top there is an extensive view of the surrounding country, all open moorland, with huge masses of granite projecting here and there; and just under it is the large quarry of this far-famed stone, which is white, fine-grained, and very durable. A little below, we were shown some stone cabins, formed by digging out the earth from under some large slabs, said to have been once inhabited by a Mr. Daniel Gumb and his family; this eccentric gentleman having a love of mathematics and astronomy, and an abhorrence of taxes. On one of the slabs some figures of propositions of Euclid are carved, and on another D. Gumb, 1735.

On our excursion to the Lizard district, we took the train to Penryn, whence the granite of which Waterloo Bridge is built was obtained. It is exactly like the Cheese-wring granite. The road through Budock and Mawnan Smith to the ferry over the Helford River traverses a very hilly country, and the banks were filled with ferns, which were none the less beautiful through being common, for we did not notice any rare species. The next village of any size is Menaccan, from which menaccanite, a variety of titaniferous iron, which was first found in a bed of a rivulet near here, derives its name. About a mile and a half to the south is a bed of hornblende slate, extending about a mile, and the Crousa Downs cover an immense bed of diallage rock, so called from its containing large crystals of that mineral intermixed with hornblende and felspar. It is locally known as Crousa stone, and is very handsome, but owing to the cost of conveyance, is not at present put to any economic uses.

Resuming our march, and passing the Chynhal's Point, we reached the Black Head, a precipitous headland composed of serpentine, as is all the country to the south of Coverack Cove on the east, and Mullion on the west coast of Lizard, with the exception of the extreme point, which is partly hornblende slate and partly mica slate. Serpentine is a hydrated silicate of magnesia, here generally of a dark green or reddish-brown colour, but the choicer varieties are often of a bright red, or black, or green with red markings, and frequently spangled with crystals of diallage, which, having a brilliant metallic lustre, give the rock a most beautiful appearance. It is frequently traversed with veins of steatite, also hydrated silicate of magnesia, which is white. At the Black Head some of the most beautiful of these veins occur. There was one vein in particular, but which is now worked out, that consisted of pure white steatite, with small fragments of green, red, and black serpentine and spangles of diallage scattered through it; it was not more than two inches in thickness, but was well adapted for paper weights and small ornaments. We found one small vein, and brought away some specimens. At Sparnick, a couple of miles further, a small mass of the Crousa stone again appears. At Kennack Cove, which is remarkable for having the greatest extent of sandy shore in the district, we obtained some fine specimens of red serpentine, with green lines across them. There is also here one of the fine-grained granitic veins which occur at various places in the serpentine. A little beyond Cadgwith, a fishing village and coast-guard station, is the "Devil's Frying Pan," a large circular chasm in the cliffs, caused by the falling of the roof of a cave at some remote period. It is 200 feet deep and 126 feet wide at the bottom, the sides are almost perpendicular. In very calm weather a small boat can enter by the mouth of the cave. A little further south is the Dolor Hugo (Hugo is Cornish for a cave: it is only used in the Lizard district), an enormous cavern, but which, being entered by the sea at all times of the tide, is only accessible by boat, and in the calmest weather. Just beyond, under Carn Barrow, is another cave in which the sea-fern, *Asplenium marinum*, grows luxuriantly.

Standing on the cliffs near the Lizard Light we could see the Land's End cliffs to the west, in the distance, across Mount's Bay; and to the east is a beautiful little bay, half a mile across, called Housel, bounded on the opposite side by the rocky headland of Pen Olver, while just below rises a lofty columnar rock, called the Bumble, which can be reached from land at low water only. The rocks are here composed of very black hornblende slate. A little to the east of the light-house is an enormous hole, known as the Lion's Den, caused, like the

Frying Pan, by the falling in of the roof of a cave beneath, the Daws Hugo; in this case the date is known—viz., 14th February, 1847.

While standing on the cliff here, at 7.48 P.M., on the 23rd August, 1864, just before dark, we saw a most brilliant meteor over the sea. Its apparent direction was W.N.W to E.S.E. It was at first of a pale yellow colour, then, bursting with a crackling noise, turned blue, and some black fragments fell.

In the morning we walked to Kynance Cove, on the west, where the rock scenery is the most beautiful we met with in our tour. The cliffs, though not very lofty, are grouped most picturesquely. The red rocks contrast grandly with the fine green colour of the sea. A large rock in the centre, which is covered with herbage, is called Asparagus Island, from the *Asparagus officinalis* which grows in abundance on it. There are several extensive caves in this cove, and it is entered by a natural archway. There are also two granite veins here.

The interior of the Lizard district is chiefly moorland, the northern part being called Goonhilly Downs, and the southern the Lizard Downs. These moorlands are covered with heath; the Cornish heath, *Erica vagans*, growing in equal abundance with the more common varieties, *E. tetralix*, and *E. cinerea*. The flowers of the Cornish heath are either red, white, or light purple. The "adder's tongue" fern, *Ophioglossum vulgatum*, grows in the district, but we did not find it. There was formerly, at Gue Graze, a large vein of steatite, or soap-rock, as it is sometimes called; but it was all quarried and carried away some years ago, principally for China clay, but it was also used in the manufacture of Epsom salts and carbonate of magnesia. We found some small pieces of the steatite, and also in a crevice in the rocks some mountain leather, a variety of asbestos. The cliffs are very dark red, and in some parts quite black; they are about 200 feet high, and very precipitous. Under the shelter of some rocks the *Asplenium marinum* and *A. adiantum-nigrum* were growing luxuriantly; and having plenty of earth about their roots, were very good for transplanting, which is not often the case with these two species. Higher up in the valley the *Osmunda* was growing in great abundance, though not more than a yard high, but it was in bushy plants. This, like most of the valleys in the district, has large rocks strewn about it, a small stream running down it, and very steep sides, so that you do not see it till within a few yards of the edge.

At Helstone we took the coach to Marazion, passing through Breage (pronounced *Braeg*), where we again entered a mining district, which stretches from here to Penzance in the west, and St. Ives in the north.

Opposite to Marazion—

> "Majestic Michael rises, he whose brow
> Is crown'd with castles, and whose rocky sides
> Are clad with dusky ivy."

On the land side St. Michael rises gradually to the height of 195 feet, while to the seaward it is precipitous. The western side is composed of fine-grained white granite, with a rather small proportion of mica. In the cavities of the granite very good crystals of white topaz occur; we found some good specimens. The building on the summit is not a castle, but a portion of the old monastery. It is now the residence of Sir John St. Aubyn.

Near Penzance is "Ding Dong" one of the oldest tin mines in the county. The names of some of the Cornish mines are very curious, such as the above and the following, "Ale and Cakes," "Ting-Tang," "Wheal Music," "Wheal Chance," "Wheal Cost all Lost," etc. Some are named after the estate on which they are situated, and others with personal names, as "Wheal Frances,' '"Wheal Eliza," "Wheal Alfred;" while others are named after natural objects, as "Wheal Crab," "Wheal Limpet," "Wheal Violet," "Wheal Primrose," "Wheal Raven," etc.

St. Just, which next engaged our attention, is surrounded by numerous mines, amongst which is the celebrated Botallack mine, two miles to the north, that runs a third of a mile under the sea. A great many minerals occur in it, amongst which are arseniate of iron, bismuthine, native copper, specular iron, and augite. We had not time, however, to visit it, but Mr. Talling has been there since, and was fortunate enough to discover several interesting species, one of which, atacamite, is new to Cornwall only, while the other two are new to science. They are all three hydrated oxychlorides of copper. One of them has been named Tallingite by Prof. A. H. Church, who analyzed and described them and the other Botallackite. The Tallingite is blue, while the other two are green, the former dark and the latter very pale. They have in all probability been formed by the infiltration of sea-water, which has acted on the ores of copper.

The morning after our arrival in St. Just, we walked to Cape Cornwall, a most remarkable promontory. Its extremity is a huge rounded hillock of killas, 240 feet high, precipitous on the seaward side, though rising more gradually from the land. About a mile to the S.W. are the Brisons or Sisters, two large black rocks, which rise seventy feet above high-water mark.

Along Whitsand Bay we saw many of the "old men's workings," whence it is supposed the Phœnicians obtained

their tin. In the shelter of some rocks here we found the "lanceolate spleenwort," *Asplenium marinum*, a fern which we had not before met with. Then passing Sennen village, we came upon a lofty, precipitous headland, called Pedn-mean-du, the "headland of black rock," from the top of which we had a good view of Whitsand Bay and Cape Cornwall to the north; and to the south, only a mile distant, the Land's End; and just below, out at sea, the Irish Lady, a large black rock. The rocks here, composed of white granite, have very much the appearance of basalt from the regularity of the cracks and joints.

The cliffs at the Land's End terminate very abruptly, and are quite perpendicular. They far surpassed our anticipations in their wild grandeur, although it was extremely calm on the day we were there, the rocks being but slightly

> "Fringed by the lace-work of pearl-threaded foam,
> That mermaid's weave, and hang along the shore."

About two miles to the westward is the Longship's Lighthouse, built on a rock called Carn Bras, the largest of the group, and in the distance the Scilly Isles, of which St. Mary's, the largest, is easily distinguished by the extent of white sand. They are about thirty miles off. Midway between these and the Land's End lie the Seven Stones, said to be the summits of hills in the fabled land of Lyonesse, which legends say was once a rich and fertile land, possessing no less than one hundred and forty churches, until by some terrible convulsion it was submerged, the only survivor being a Trelawney, who swam away on his white barb, which is still the cognizance of the family. It is celebrated in the "Idylls of the King," where

> "All day long the noise of battle rolled
> Among the mountains by the winter sea,
> Until King Arthur's table, man by man,
> Had fallen in Lyonesse about their lord."

But geologists are of opinion that no such great change can have taken place in historic times.

A little to the south of the Land's End, close under the cliffs lies the Dollah Rock, and a little further out, an enormous mass, nearly 200 feet high, called the Armed Knight, from a rock at the top resembling a man's head, and the columnar granite looking like armour; and more to the south, an island called Enys Dodman, that has a cavern forty feet high running through it. We then followed the line of the cliffs passing Pordenick Point, a bold headland, showing the columnar form of granite to perfection; next Carn Voel, and then Carn Evall, the western boundary of Nanjizel or Mill Bay, one of the most beautiful on the coast. The latter name is owing to a

mill, now in ruins, on the stream which falls over a series of small cascades through a natural archway into the sea. It is bounded on the south-east by Carn les Boel, the "carn of a bleak place," which is penetrated by a lofty but narrow cavern, called Zawn Pyg, "cave like a bird's beak." We entered one of the "old men's workings" here, being prepared with a candle and matches. It only extended about thirty feet, for in those days the miners did not like to go too far underground for fear of the gnomes and pixies. We picked up some good tin-stone in it.

The famous Logan Rock, which weighs about eighty tons, is situated on a pile of rocks about thirty feet high, near the extremity of a long and narrow precipitous promontory, called Treryn Dinas, the "castle of the fighting place." The entrance is blocked by an immense pile of rocks, leaving only a narrow pathway, so that it could easily have been defended. There are the remains of some earthworks round it. It requires some strength to rock the Logan Stone. It was said to log much better before its overthrow, in 1824, by Lieut. Goldsmith, who, having heard the country-people's tradition, that though

> "It moves obsequious to the gentlest touch
> Of him whose heart is pure,"

it was impossible that any force could remove it; so one evening he went ashore with some seamen from his cutter, and with powerful crowbars capsized it; but it was fortunately caught in a ledge of rock, and did not roll down into the sea. He had, however, to pay dearly for his amusement, for the enraged Cornishmen appealed to the Admiralty, who gave him a hint that his commission was in danger unless he restored the rock to its former position, which he did by means of machinery from Plymouth Dockyard.

The celebrated Druidical circle of Boscawen-ûn, is situated a mile and a-half to the north of St. Burian. It consists of nineteen large granite pillars, varying in height from three to six feet, in a circle, and a taller one, which slopes a little in the centre; three of them have fallen.

In a valley, or "croft," as it would be called in this part, that runs down from Boscawen to Lamorna Cove, the most beautiful and rarest of the English heaths, *Erica ciliaris*, grows.

A tour in Cornwall would be sadly incomplete without paying a visit to King Arthur's Castle on Tintagel Head, a lofty square rock five or six hundred feet high, precipitous on all sides, and nearly surrounded by the sea. It is called by the natives "the island." It is only accessible from the corner by which it is joined to the mainland, and that only by a

narrow, zig-zag footpath up the face of the cliff. Not much of the walls now remain, as it was built more than fifteen hundred years ago. From the summit we could see along the coast line as far as the Hartland Point, with Lundy Island to to the north, and to the Pentire Point on the south. The coast scenery here is certainly much more beautiful, with the exception of Kynance Cove, than any we had seen before, though the cliffs were not quite so grand as the granite ones of Land's End. On the northern side of the castle is a small bay, where the slates are shipped, and which are

"the sands
Of wild Dundagil by the Cornish sea,"

where the infant prince, who grew up to be the glory of Cornishmen, and the lord of the castle above, was found.

On the opposite side of the bay is a fine headland called the Barras Nose, which seemed a great attraction to artists, for one morning there were four sketching it.

Not far from the castle I found the true "maiden-hair fern," *Adiantum Capillus-veneris*, growing very abundantly. The fronds had very large pinnules.

Two miles east of Tintagel is a most beautiful valley abounding in ferns; in the lower part the *Asplenium marinum*, and even the *A. lanceolatum* were quite common. The rocks here are very fine, while higher up it is well wooded, and at about a mile and a-half from the sea is the fall of St. Nighton's Kieve. The fall is divided into two parts—the water first falling about fifty feet, then passing through a cave, and falling twenty feet more. Every ledge and crevice in the rocks was occupied by ferns, but we did not notice any that we had not before seen in Cornwall, though our guide said that every English species grew there. He told us the *Adiantum* grew in the valley, but kept the exact spot a secret. Just above the fall are the ruins of the cell of the recluse from whom it has its name.

One day we went on to Boscastle, where there is a small harbour, and around which the cliffs are very grand, and another day across Trebarwith, noted for its large extent of sandy shore, on to Tregarget beach, where there is a deserted mine, passing several slate quarries on our way, and in one valley we saw an immense quantity of *Osmunda* on the banks of a small stream.

In the neighbourhood of Camelford, the "forked spleenwort," *Asplenium septentrionale* occurs, but I did not find any specimens of it, though I found "Wilson's film fern," *Hymenophyllum Wilsoni*, or *unilaterale*, a short distance off. Near Camelford is Rough Tor, which the people pronounce *Rowter*, one of the grandest of the Cornish hills. It is 1296 feet high,

while Brown Willy, the highest hill in Cornwall, which lies about a mile to the south-east, is 1368 feet above the sea level. Rough Tor is strewn with large rough blocks of coarse-grained white granite, whence its name; and amongst them were a number of half wild goats.

Before I went down into Cornwall I heard all sorts of absurd tales of "West Barbary." For instance, that no trees grew there; which is true as regards Bodmin and the other great moorlands, and the Lizard and Land's End districts, but the rest of the duchy is luxuriantly wooded. And then again that it rains "two days out of three," while I found the average to be one day in seven or eight.

NOTES ON A WINTER VISIT TO MOUNT ETNA.

THE ERUPTION OF 1669.

BY PROFESSOR D. T. ANSTED, F.R.S.

I ARRIVED at Catania from Taranto on the 27th January, 1866. Etna was then covered with clouds. The wind was from the north, and cold, and the sea had been much disturbed. The view of the mountain is always grand; but the effect on this occcasion was not equal to that produced when I had seen the mountain from the sea in June last. There was more snow than is usual in January, and a moderate escape of white smoke from the crater. The snow was pretty continuous about 6000 feet down from the top, that is, from the height of about 5000 feet from the sea. The lavas of 1669 are very striking, as seen on the south side of the town on entering the harbour, and they fully prepare the traveller for the volcanic phenomena of the district.

The history of the eruption of 1669 has often been published. It is written so clearly in the cones, craters, ashes, and lava-currents between Catania and Mount Etna—places still remaining in a state absolutely unaltered, and that can be visited from Catania with the greatest ease—that no better standard of comparison for volcanic phenomena of recent date can be imagined. It is exemplified further in a rich variety of mineral products, including crystals of the most perfect form, pseudomorphs in enormous abundance, and coloured scoriæ of the most brilliant hues. All these cover a wide district, cultivated to a certain extent during summer, but in the season of winter and early spring only here and there enlivened by the Indian fig and the blossom of the almond-tree.

The cone and crater formed during the great eruption of 1669 are still wonderfully perfect and extremely interesting. They are between twelve and thirteen English miles from Catania, towards the north, and on the outer verge of that great circular area of scoriæ, lava, and innumerable volcanic cones that characterize Etna. This area is included within a radius of about ten miles from the principal crater, and there is but one cone (supposed to be mediæval, but probably older) at any considerable distance from it.

The principal cones of 1669 are described as three, but consist in fact of one twin cone with a double crater and one smaller cone. The former is known as the *Monti Rossi*, or red hills, from the singular amount and well-known colour of the peroxide of iron colouring the scoriæ, of which the two apparently distinct cones are made up. There are a few other small cones of the same eruption, but none are of any importance. The second principal cone is the *Grotto delle Palombe*. All rise abruptly out of a sloping surface of intensely black lapillæ, and ashes composed of fragments varying in size from a pin's head to a pea, occasionally mixed with others rather larger. These are scoriaceous, but hard. This bed of intensely black and hard ashes covers the remains of the old village of Nicolosi; the modern town of that name is adjacent. The level of the ashes at the foot of the cones I found to be about 2160 feet above Catania.

The first cone I visited was that of the Grotto della Palombe. It consists chiefly of lava. Its highest summit is about 370 feet above the plain; but one side is much lower than the other. Ascending the lower side on ashes and scoriæ, an oval crater is seen, and may be entered without any difficulty. One may descend into it to a depth of sixty feet below the highest part of the cone. The bottom is covered with loose scoriæ, but the walls are of lava, in layers of different thickness, imperfectly stratified. The beds of lava do not dip at any considerable angle. The lava is partly cellular, but more generally compact. In the bottom of the crater, in the direction of the Monti Rossi, is a hole about twenty feet deep, and about twelve feet in circumference. From this hole there was formerly a passage for many yards into a large cavity, supposed to be under the Monti Rossi craters, and at any rate communicating with them, and all forming part of one principal fissure. It is probable that lava issued from this fissure before the great outflow commenced, and it would seem that there were many successive layers, so that the core of this part at least of the cone is formed of hard material.

From the Grotto della Palombe there is a descent over black scoriæ, now covered with vines, and then we rise upon

the cones of the Monti Rossi. The height of the principal cone, according to my barometric measurement, was 2920 feet above Catania, and 750 feet above Nicolosi, or rather above the ashes at the foot of the cone. The cone is now chiefly composed externally of fine ashes mixed with coarser lapillæ, and the ascent is rather difficult for mules, in consequence of the steepness of the wall and the looseness of the ashes. Once at the top, a curious ridge is seen running along in the direction of the longer axis of the cones, whose horizontal section is oval, and which, as I have said, form but one hill. There are, however, two distinct craters, separated by a ridge of hard and tolerably compact lava. The walls of the double crater are alike, and are both composed of stratified tufaceous matter, enclosing innumerable crystals of pyroxene, often quite perfect, but generally small. These are detached, and are picked up in great numbers on the slopes. Many of them are grouped, and twin crystals are common. Large parts of the interior of the craters, and even parts of the extremity of the cones looking towards Catania, exhibit the most brilliant red, orange, and other tints, and much mineral of a delicate yellowish white, enclosing pseudomorphs of pyroxene.

The principal crater—the largest in diameter and the deepest—is that towards Catania, or on the side from which the lava began to pour. The depth at present is 325 feet below the highest part of the cone. The crater presents but little compact lava, but a great deal of scoriaceous lava and numerous detached blocks that are very compact. The scoriaceous lavas are much encrusted with salts of various kinds, and these are very interesting in a chemical point of view, being evidently the result of vapours that have passed through the rocks during and after the eruption.

The craters, both the larger one to the south and the other towards Etna, are both elongated, and tolerably regular. The ridge between them is exceedingly narrow at the top, the average width not exceeding five feet. It is about 125 feet above the bottom of the principal crater, and therefore 200 feet below the highest point of the cone. The smaller crater I did not descend, but it appeared to be somewhat less deep than the other. It was entirely covered by scoriæ, and presented less discolouration and incrustation than the other, or northern crater.

On the whole of the eastern side of the double crater, but chiefly on the part towards the south, the walls of the crater are distinctly stratified, and consist of soft grits made up of volcanic sand of various colours, with crystals of pyroxene. These beds are often deeply coloured. They dip to the south-west at an angle often amounting to 45° or 50°. The height of

this eastern side of the cone is about sixty feet below that of the western, and here the stratification is most clearly seen. Where there is nothing but loose ash, the angle of inclination is about 23°, and of real solid compact lava there is hardly any near the summit, though there is one nearly vertical dyke near the ridge, separating the craters. Nothing can be more beautiful in colour than the extremity of both cones towards the south, and it is evident that at this point there has been the largest amount of chemical change.

On descending the slope of loose ash on the face of the cone towards the south, the visitor cannot fail to be struck by the number of rocky fragments that come out from the ash, forming here and there a kind of rocky wall. This is the point at which the lava originally began to flow. There are two such points, both, no doubt, representing fissures. They are not far apart, but one is considerably below the other. The lava from both is wonderfully compact and hard. It is evidently in layers, and consists of floods that have rolled one over another, leaving occasionally large open spaces or caverns, some of which are laid bare either by quarrying or from accident. The lava when thus seen is always full of air-blebs or vesicles at the actual surface, at the centre of the two beds, and in the interior of the cavities, but generally exceedingly compact, at a distance of a few inches from such surfaces.

We thus see at the Monti Rossi the phenomena of the first commencement of a volcanic eruption. There are the scoriæ and lapillæ that were erupted before and during the out-pouring of the lava, the great flow of ashes that buried the old village adjacent, the uplifting of strata of compacted volcanic mud, the dykes of lava in the interior of the cone, the chemical changes that have affected the scoriaceous lavas, and the lava itself as it first burst out from the earth, and moved along in a pasty state over the surface. From the summit of the cone one can distinguish with perfect ease and with the utmost clearness the course of the sluggish black flood as it crept along and covered the surface, leaving blackened and still uncultivable rocks along the whole distance between the cones and the sea coast. We can trace it as it swept round a much older volcanic cone, half a mile distant from the newly-raised mountain, and observe the outline as it again united and advanced towards Catania. Let us next endeavour to make out the condition of the mass when it reached the end of its course, and after advancing thirteen miles, entered the sea and was lost sight of. All is laid bare, everything is as clear as if it had happened yesterday, and though to some a bird's-eye view of Sicily from the summit of the giant mountain may have greater charms, a few hours spent in the investiga-

tion of the lava current of the Monti Rossi will be much more instructive to the geological student.

Between this cone of 1699 and the summit of Etna, there is no evidence of modern eruption, and nothing but a repetition of similar phenomena of great though unknown dates. There is very little difficulty in following the course of the modern eruptions, as they have rarely interfered with each other or crossed each other's courses.

Near Catania, and within the town, there are matters of great interest connected with the lava-current of 1699. The lava reached the western extremity of the town. Diverging at a small rise in the ground it formed two currents, one overtopping the town wall at least sixty feet, and running over. The wall, however, was not overthrown, but may still be seen little altered, with the strata of lava not touching it, though coming quite close to it on the side towards the sea. Elsewhere, the lava threw down the walls and entered the city.

Creeping on, it at length passed beyond the coast line, entering the sea and connecting a small rock, on which was a castle, with the mainland. The castle and the bridge thus formed still remain, but there is now no appearance of an interval. The breadth of the lava was here nearly two miles, and the tongue of rock, forced onward in a semi-fluid state, extended far into the sea. The present lighthouse is built on the furthest extremity of it; and the whole of that portion from the castle onwards that has not been actually built upon, exhibits a most striking and extraordinary illustration of the surface of a flood of lava. It is utterly barren, except that at distant intervals there are a few patches of yellow lichen. It is so rugged that one can only walk over it with difficulty, and at the risk of cutting the leather of one's boots, and breaking a limb if one should chance to fall. It is also fissured here and there with deep chasms. These latter were probably produced during rapid cooling, and perhaps the mass was partly cooled in the water, steam at a very high temperature having been formed beneath, and tearing asunder large fragments.

I noticed in one spot a column of marble that had originally formed part of some building still remaining in its place, and still vertical, but buried in a whitish and altered rock, and covered entirely by horizontal beds of lava. The substance below had been partly worn away by the weather, and the column was laid quite bare. The lava above was compact and unaltered.

In the field of lava thus presented, there is abundant evidence of the successive layers by which the whole mass has been accumulated. At various places the surface has been broken away for building purposes, and then we invariably see com-

pact bands (scoriaceous both above and below), alternating with each other. Large cavities are occasionally shown, and near these the rock is full of air on the inner surfaces, though the walls inclosing them are often extremely rough and rugged. Where the sea has access, it has taken advantage of the cavities, and has undermined the rock to some extent, but few substances are so well able to resist the action of the waves as compact lava, whether of ancient or modern date.

Some expressions occasionally made use of in speaking of lava currents are extremely inaccurate. Such a thing as a flood or rush of lava has never been known in nature. Lava issues but slowly from the earth, and even when it moves down the steepest slope it advances very slowly close to the point of issue. That which overspread Catania moved with unusual rapidity, but it required twenty days to travel its first eleven miles, with an average fall of one in twenty-five. The remainder of the distance (two miles) required twenty-three days more. Even in very rapid flows, at their most rapid rate, four hundred yards an hour, or about twenty feet in a minute, would be an extraordinary pace.* Far more commonly the rate is not more than three or four feet per minute, and often it is very much less. A current of lava, therefore, although it may occasionally do great mischief, can hardly arrive at any spot without ample notice. This is not the case with the ashes and other substances erupted, or with earthquakes. The former are often so abundant and come on so rapidly and unexpectedly that they entirely bury and destroy villages and towns. The latter devastate large areas, and are much more destructive than the lava-currents, commencing, as they do, without any warning.

Thus, then, we have in the phenomena that now remain of the Etna eruption of 1669, nearly two centuries ago, a connected history of one of the earliest great volcanic disturbances that has been minutely recorded in modern times. The disturbances commenced with earthquakes, which affected extensive areas. Large quantities of aqueous vapour, and various gases were erupted from long and wide clefts in the earth. Fine dust was carried to a great distance, and spread deeply over the surface. Enormous quantities of ashes and scoriæ were thrown up in the air, and fell upon the spot where the eruption began. These last accumulating round solid fragments of rock thrust up from below, and being intersected by melted lava not yet erupted, formed at length a large and lofty hill which has remained to this day with very little change. After all this came forth the lava-current, a semi-fluid mass of solid crystals buried in a tenacious glassy paste, oozing out from the

* Lava, however, has been known to descend short distances on a slope of 25° at the rate of three feet per second.

clefts and crevices produced by the pressure upwards of the pent-up steam and gases, and thus forced above the surface. Unable to accumulate there, the layers of this paste rapidly succeeding one another, spreading over the earth, taking soon a definite direction, and lazily pushing themselves along, filling up inequalities, and at length covering and burying villages, cultivated lands, pools, streams, and springs, and terminating only under the sea.

Such as it was ten years after the eruption had ceased, this lava-current remains now a great desolate tract of black cinder, exhibiting in every part the history of the event to which it was due, and illustrating one of the great powers of nature. The whole of the country around Etna is the result of a succession of such actions, extending over a part of the tertiary period into modern times. Geologically, Etna is not old, although there is no evidence to show the exact date of its earliest eruptions. They probably began with little, and have become greater as the mass of erupted matter increased. It is, however, remarkable, that of all the many cones and craters with which the surface is covered, the great central crater of Etna is that which still communicates most directly with the interior exhibiting this by the emission of constant vapour and gases' The numerous subordinate and lower craters, once so noisy and active, have long since been choked up, but this remains. There have been many eruptions of ashes and lava from the principal crater within the last hundred years, though the chief lava-currents have come from fissures at a much lower part of the mountain.

My object in this notice has not been to reproduce the accounts of the eruption of 1669, which are well known to geologists and are easily accessible. I have wished rather to show that the student of geology at the present day may still learn from indications of the event yet remaining a number of valuable lessons. A comparison of this eruption and its attendant phenomena, with the smaller, but not unimportant eruption of Etna that took place last year, made by an eye-witness of the present state of the mountain, may be interesting to the readers of the Intellectual Observer, and I hope to be able at another time to communicate the results of my visit to the other side of Etna.

PRE-HISTORIC MAN IN FRANCE.*

Amongst the recent losses to science which have been occasioned by death, that of Mr. Henry Christy was, from his early age and talent, one of the most deplorable. He rendered distinguished services to geology and archæology by the zeal and liberality with which he conducted and promoted researches in the valley of the Dordogne; and as the preface to the first part of the *Reliquiæ Aquitanicæ* states "he was carried off in the midst of his self-imposed and well-directed work, by acute illness, brought on by over exertion in a visit to the Belgian bone caves, not long after the first few sheets of this book had been put into the printer's hand." We are further informed that he had arranged its style and mode of publication. Many of the plates had been drawn and lithographed in Paris under his and M. Lartet's superintendence, and of some he had prepared descriptions. Upon M. Lartet devolves the task of completing this splendid work, which will be edited by Professor Rupert Jones. "Mr. Henry Christy's executors, desirous of fully carrying out the last wishes of their brother, are resolved to give every assistance in producing the book in the style he contemplated." Every reader must feel a tinge of sadness at the *in memoriam* character thus given to a work which it was hoped Mr. Christy, as well as M. Lartet, would have lived to finish, and to enjoy that honourable recompense of praise which awaited its publication. The determination of Mr. Christy's executors to carry out his design will meet with general sympathy, and we congratulate them on the issue of the first part, which is produced with as much beauty of type, paper, and illustration as the most ardent admirer of their brother could desire.

After some preliminary observations, the work begins with a description of the physical features of the Dordogne district. It is now accessible by the rail from Paris, through Orleans, Limoges, and Pèrigueux. "After passing the last-named town about eighteen miles, and descending the valley of the Vèezre, between the stations of Miremont and Les Eyzies, the eye is struck," say the writers, "by the sudden change which affects the physical aspects of the country. The two sides of the valley rise in great escarpments of massive rock, more or less interrupted by ancient falls. Their summit is usually crowned by projecting cornices, below which are great horizontal niches or hollow flutings." These curious "flutings" are exhibited

* *Reliquiæ Aquitanicæ*; being contributions to the Archæology and Palæontology of Périgord, and the adjoining Provinces of Southern France. By Edouard Lartet and Henry Christy. Baillière.

on both sides of the valley, and at first sight suggest the idea that they are lines of erosion resulting from strong water-streams. They are, however, traced to the tendency of the fluted beds to scale off under the influence of weather changes. In the valley thus bounded are numerous caves and recesses, as is common in calcareous formations, and remains still exist of the Rock of Tayac, a mediæval fortress hollowed out of the rock, and which sustained more than one siege.

The caves examined by MM. Lartet and Christy are situated in the United Communes of Les Eyzies and Tayac, and in the adjacent communes of Tarzac and Peyzac. The remains of human industry discovered in these caves are not uniform in character, "although within the chronological division of simply worked stone, without the accompaniment of domestic animals." Thus at Laugerie Haute worked flints, like lance-heads were comparatively abundant, but there there were no implements of reindeer horn, though the latter were "found in great numbers at Laugerie Basse, at La Madeleine, and at Les Eyzies, where scarcely any of the flint lance-heads have been met with."

Sculptured figures of animals have as yet only been found at three stations—Les Eyzies, Laugerie Basse, and La Madeleine. The cave of Moustier yielded worked flints of a special type, and others like those common at St. Acheul and Abbeville, but no worked bone or sculptured animal figure. "Nevertheless the fauna of the several stations appears to be almost the same, only at Moustier the reindeer is less dominant numerically than at the two Laugeries, at La Madeleine, and at Les Eyzies." Separate plates of the molar tusk of the elephant (*elephas primigenius*) have been found at all the five stations; worked ivory has been met with at Les Eyzies and La Madeleine, and at Laugerie Basse a portion of the pelvis of an elephant.

No bone of a domestic animal has been found in either of the five stations mentioned, neither have any of the stone implements an artificial polish. "These two circumstances," say the writers, "suffice to distinguish definitely this first period of the age of stone simply worked, from the second period, when polished stone comes before us, together with domestic animals and habits of agriculture quite unknown to the earlier natives." In a note it is suggested that the men of the first period may not have been ignorant of the art of polishing stones, although they did not polish their implements. Between the two periods, MM. Lartet and Christy consider a great lapse of time must have occurred to account for the disappearance of the reindeer, of which no traces occur in the lake dwellings of Switzerland, or in caves of the same age.

In certain cases the animal remains found in the caves may

have been transported to them by carnivorous beasts, and in others the supposition of their having been transported thither by floods and torrents may be admissible; but in many cases the presence of works of industry bear testimony to the action of man.

The *Reliquiæ Aquitanicæ* are issued in a quarto form, which gives ample space for large illustrations. In the first part we find four plates of stone implements, and two of bone implements. The figures of flints represent the blocks from which the flakes have been struck, and the various forms of the weapons produced by more or less elaborate working. The bone implements figured consist of barbed arrow or spear-heads, and pieces of bone sculptured with figures of fish and quadrupeds, and in one instance with a human figure. The drawing of these figures indicates considerable practice in delineating living objects, and the figures are by no means destitute of expression.

The human figure occurs on one side of a cylindrical rod, in company with the heads of two animals referred to the bovine genus, two horses' heads, and an object which may be a serpent or an eel. This is a highly curious work of art, and the human figure is not badly outlined, though details of the face are omitted.

When costly works like that of MM. Lartet and Christy come before us, we cannot help regretting that our country has not sufficiently advanced in civilization to possess many public libraries likely to purchase it. Rich collectors gladly buy expensive books of this kind, and they ought to be made generally accessible to students by public libraries in every town.

NOTES ON THE COMPARATIVE GEOLOGY OF THE EARTH AND MOON.

BY HENRY J. SLACK, F.G.S., MEMBER OF THE COUNCIL OF THE MICROSCOPICAL SOCIETY OF LONDON.

THE classical scholar will, I am afraid, at first object to the collocation of such terms as "geology of the moon." He might accept selenology for the science meant, just as selenography has been accepted as the appropriate designation of the art of depicting lunar formation; but *ge*ology he will say is a discourse about this earth, and the Greek word from which the first half is derived cannot be made to comprehend the moon. It does, however, seem reasonable that we should consider all celestial bodies of the same class, such as primary and secondary planets under one generic appellation, "earths," and if so, we might speak of "comparative geology" as the science which considers them as members of the same group.* By and by, perhaps, we shall have "heliology" to designate the science which endeavours to unfold the structure of the sun, and if so, "comparative heliology" may be admissible to describe the science which seeks to elucidate the comparative structure of all bodies which may be collectively termed *suns*.

It is impossible to look at the moon without instituting comparisons between the mountains, plains, and cavities of that body and those of our earth; but certain preliminary inquiries seem necessary before we can arrive at any conception of the extent to which such comparisons are likely to hold good. Suppose, for example, the nebular hypothesis is assumed as the basis of such investigations, we should then refer both the moon and the earth back to some enormously remote period, when they were condensed from a vaporous condition to one of a fluidity and plasticity resulting from heat. Such may have been the origin of our globe, but vain would be the search for specimens of the first solidified crust. Probably no portions of the earth which we can get at, by ascending its mountains or mining into its depths, represent the original solids that were first formed by the cooling and contraction of the ignited fluids, which, according to the nebular hypothesis, were the parents of the earliest solid forms. Changes from water action, which must have been, in geologic time, long posterior to any incandescent state of the earth's surface;

* Sir J. Herschel uses the term "geology of the moon;" so it may be considered established. *Astronomy*, 7th Edit., p. 283.

changes from chemical and electrical action rearranging the molecules of solids; these may have gone for unknown cycles of ages modifying and remodifying all the matter accessible to us, which may have originally resulted from the various steps and stages of nebular condensation.

In the address recently delivered by the late President* of the Geological Society, he suggested the probability that the earliest plastic condition of the earth of which we find traces, may have resulted from aqueous and not from igneous causes. Were this proved to be the case, it would not follow, as he intimated, that the earth was not once an incandescent ball, the cooling of which proceeded from the circumference towards the centre. All that we should be entitled to affirm from the most convincing proof that many of the rocks now called igneous were of aqueous origin, would be, that the traces of the pre-existent state had disappeared through the successive operation of causes in which fire played a secondary, and not a primary part. The assumption that the earth was once fluid, or pasty, from heat, is quite consistent with a second assumption that the principal cause of plasticity in ages long posterior to those of fire, may have arisen from a partial solution of materials, in which water was the chief agent.

If these theoretical views be provisionally accepted, there may have been two terrestrial periods of more or less plasticity, an igneous and an aqueous one, and our times may be so far down in the aqueous ages that we may not be able to trace any strata so far back as even to approach the commencement of the aqueous period.

Looking from the earth to the moon, we must be struck with evidences of great plasticity having prevailed when numerous tracts of selenian scenery were shaped into a prodigious number of craters, with lofty walls bearing greater or less traces of subsequent change. Mere violence of explosion without a greater plasticity than we are acquainted with, through terrestrial formations, could scarcely account for what is observed. The volcanoes of the Sandwich Islands, and those of Central France, so ably elucidated by Mr. Scrope, bear the greatest resemblance in character to lunar craters; but even the former are pigmies in point of breadth, and were probably formed under different conditions of plasticity in the crust of the globe to which they belong.

A volcanic cone might be formed under some circumstances as a "crater of elevation;" and Von Buch, Elie de Beaumont, and others have conceived our terrestrial volcanoes to have had such an origin. A "crater of elevation" means a cone formed by raising up in a huge bubble, strata that were pre-

* Mr. Hamilton.

viously horizontal, and throwing out any matter that might occupy the central part. As Sir C. Lyell and Mr. Scrope have shown, our volcanoes do not exhibit the appearances that would indicate such an origin, and the more probable opinion is that they were formed by outpourings of matter through volcanic vents. "In the Sandwich Islands," to which we have referred, Sir C. Lyell says, "we have examples of volcanic domes 15,000 feet high, produced by successive outpourings from vents at or near the summit." * "The usual slope of these sheets of lava is between 5° and 10°; but Mr. Dana convinced himself that owing to the suddenness with which they cool in air, some lavas may occasionally form on slopes equalling 25°, and still preserve a considerable compactness of texture. It is even proved he says, from what he saw in the great lateral crater of Kilauea, on the flanks of Mount Loa, that a mass of such melted rock may consolidate at an inclination of 30°, and be continuous for 300 or 400 feet. Such masses are narrow, he admits, but if the lava had been more generous, they would have had a greater breadth, and by a succession of ejections overspreading each cooled layer, a considerable thickness might have been obtained."† Mr. Darwin, likewise, describes in the Galapagos Islands, hills composed of tuff which must have flowed like mud, and yet consolidated at inclination of 20° or 30°.

If a volcanic cone were formed by elevation of hard horizontal strata, they would be cracked in directions radiating from the centre of the elevating force; and Sir J. Herschel says, that in Lord Rosse's telescope the exterior of the lunar mountain Aristillus is all hatched over by deep gullies radiating towards its centre.

Our terrestrial craters are of various ages, but none date back to the remoter periods of the world's history, which preceded the deposition of sedimentary rocks. But while all our terrestrial volcanoes belong to the period of *aqueous* stratified rocks, what are we to say concerning those of the moon? Did they originate in a period *preceding* that of aqueous stratification, if such a period as this last ever existed in our satellite, or are they referable to a period of aqueous stratification that has passed away?

If they do not belong to any period of aqueous stratification, they cannot admit of any close comparison with our own volcanoes. Supposing the nebular and condensation theory of planetary formation to be true, a period of *igneous* stratification may have existed in the earth or moon before the period of aqueous stratification arrived. Melted matter in cooling tends to arrange in layers corresponding with the specific

* *Principles of Geology*, 9th Edit., p. 419. † *Ibid.*, p. 383.

gravities of the various substances in fusion, and it is plain that strata might be formed and dislocated by igneous as well as by mixed aqueous and igneous means.

Many of the terraced crater walls in the moon correspond with what we should expect if they originated from successive ejections through volcanic vents, but if they were formed under general conditions similar to those of terrestrial volcanic activity, it is very remarkable that all should now seem *extinct*, or that we should have only faint and scarcely conclusive evidence that any of them are still in active operation. If the Selenians have watched our earth for the last thirty or forty years, through tolerable telescopes, they must have witnessed considerable volcanic change, as about twenty volcanic eruptions are estimated to occur in each year, and yet their globe or the half of it we see has been as quiet (in appearance) as if all its energies were dead.

The inquiry whether the moon has now or has ever had an epoch of aqueous stratification is by no means easy. Many of the "water tool marks," as Mr. Campbell would call them, that can be discerned on our globe could scarcely be discriminated on the moon with present optical means. The Sinus Iridum looks much like a hollow worn by water on a rocky coast, but similar *general* appearances might result from fusion, irregular cooling, and explosive escape of gaseous matter. Near Aristarchus is a wriggling, precipitous valley that puts us in mind of the Cañons of the Colorado, but how shall we distinguish this and similar formations from the cracks that occur in castings, and which are sometimes curved?

Sir J. Herschel observes concerning lunar craters that "their enormous and vast depth are easily reconcileable with what we know of the special conditions which prevail on the moon's surface. For while on the one hand the force of volcanic explosion and ejection is nowhere dependant on the total mass of the planetary body on which the volcano may subsist, the repressing power to prevent an outbreak, which is the weight of the incumbent matter, is only about one-sixth of what an equal mass of overlying matter would exert on the earth." He likewise mentions the greater distance to which erupted matter might be carried in the moon, and the absence of the resistance afforded by our atmosphere. Such considerations are highly important; but does not the regularity of hundreds of adjacent craters require us to believe that when they were formed, the moon's surface was not in a hard, brittle state?

The question of the possible existence of masses of fluid on the moon is usually narrowed to the consideration of whether *water* is there. The lunar climate forbids the idea

that water, or snow, or glacial ice exists there *now*,* whatever may have been the case in past times. Sir J. Herschel says, "The climate of the moon must be very extraordinary; the alternation being that of unmitigated and burning sunshine, fiercer than an equatorial noon, continued for a whole fortnight, and the keenest severity of frost, far exceeding that of our polar winters for an equal time." If water in any of the forms in which we know it, existed on our satellite, the heat of the lunar day would abundantly evaporate it, and the first touch of the cold of the lunar night would precipitate it in clouds and tremendous floods of rain, or lumps of ice. At the moment of a lunar region passing into night or day, these changes would be violent, and would surely be seen to some extent by terrestrial observers. They would, moreover, produce enormous abrasions and degradations of surfaces, of which evidence would appear.

The supposition, that although water in its various forms does not now exist in the moon, it may have been there in former times, and may, by river and glacial action, have modified the surface, is very difficult to deal with. When we can get no specimens of alluvial soil, can the general aspect of a country imperfectly seen, by reason of great distance, do more than suggest an hypothesis to be lightly held? And if certain lunar formations are ascribed to glacial action, how shall the theory be satisfactorily tested? On the earth, such action is presumed from a number of indications, many of which must elude our investigation when directed to a distant body. Scratches and grooves made in hard rocks by glacial ice could not be detected, nor could the polish of surfaces, from a similar cause. The spread of gravel and drift we could not hope to discern; but large moraines, containing a great quantity of large blocks, *might* be visible, but no special water-marks upon them would be within reach of our largest instruments. Who, for example, could tell a rounded boulder from a sharp-angled rock 240 miles off? And few observers can see the moon as near as that, or anything like it. Mr. Webb, in his *Celestial Objects*, well observes, "The Moon Committee of the British Association have recommended a power of 1000; few indeed are the instruments or the nights that will bear it; but, when employed, what will be the result? Since increase of magnifying power is equivalent to decrease of distance, we shall see the moon as large (though indistinct) as if it were 240 miles off." What should we think of a geologist who discussed the action of extinct glaciers in Wales, or the parallel roads of Glenroy from the appearance they presented through

* This remark refers to the half of the moon which we see. No reference is made to the speculation concerning the character of the invisible side.

a tourist's telescope, some ten miles from the object he undertook to investigate? The details—as we call them—we may observe in the moon, would appear large features, if we were near them, and real details must (with present means) remain unknown.

It is possible that a fluid may exist in the moon which does not give off appreciable quantities of vapour, even at her enormous day temperature. A modification of the molecular condition of fluids we are acquainted with, greatly affects their boiling points and vaporisibility. Thus, water evaporates in dry air, even when in the condition of extremely cold ice. Add to that water, in certain proportions, the substance called anhydrous sulphuric acid, which melts at 65°, and boils at 110°;* and the compound, strong sulphuric acid, gives off no vapour at common temperatures, and does not boil below 640°. If, however, there should be a fluid on the moon which does not evaporate under solar heat, there could be none of the circulation which belongs to a system of rains and rivers, and thus the geological phenomena of denudation, arising from incessant water motion, would not be observed.

Attempts to unravel the mysteries of lunar geology should be consistent with the whole group of lunar appearances. For example, if one observer fancies he traces existing glaciers, and another thinks he finds proof of wave action and coast formation, while a third treats the great volcanic region spread around Tycho, as evidencing igneous forces acting on a surface plastic from heat, it is evident that such observers refer to conditions not likely to be contemporaneous. The action of existing glaciers is not compatible with the probabilities of lunar climate, but putting that aside, it is not likely that one part of the moon's surface belongs to a purely igneous period of plasticity, and that adjacent surfaces belong to a period of aqueous plasticity. If one period followed the other, it is of course possible that we might witness the early work of the aqueous period, during which the primitive igneous work would remain in certain districts unchanged. But there is no evidence of *present aqueous action*, and therefore, if part of the surface we see is referable to the igneous period, which preceded the condensation of vapour into water, and another part belongs to an aqueous period, this aqueous period must have passed away before it had time to obliterate, as it has done on the earth, the special fire marks belonging to the date at which the first mountains were formed by the cooling of a melted mass, upheaved by internal force. On our earth we trace in one place action of fire, and in another action of water; but both belong to the same period, in which the general surface and subsurface were

* Miller's *Chemistry*.

comparatively cool, and which must be long posterior to a previous period (if it existed), in which the crust was fluid or pasty from excess of heat.

The rate at which geological changes have gone on in the moon may not be the same as on the earth. The satellite may be in an earlier or a later condition than the primary, not so much from difference of actual age as from the varying velocities with which changes have been produced.

Although heat forces have had a great deal to do in the upheaval of some terrestrial strata and the sinking of others, yet the principal agent in making our earth crust what it is, was water, in that incessant motion which solar heat imparts to it. Here myriads of tons assume the form of vapour; then they fall in rain, filling the rivers; then they drop down in snow fields that feed huge glaciers; and in various ways they transport solid matter from one place to another, pulling to pieces every formation on which they fall, or over which they scrape, and sorting and lifting the materials into new strata, which in due time are upheaved. Take away all the effects of aqueous action from our globe—not only of that which now exists, but of that which has been—and we should revert to the aspect which it presented in its igneous days, when it consolidated sufficiently to acquire any permanency of form. Without water action our earth might perhaps have been almost stationary and quiescent for ages succeeding the cooling of its crust. Is this the lunar condition? Or may we hope that, though the evidence is difficult to collect, we may ultimately discover that activities and energies are at work as vigorously in the quiet, grey plains, and in the glittering mountains of the queen of our night as they are in the globe she illuminates with the borrowed splendour of her fascinating light?

ARCHÆOLOGIA.

THE INSCRIBED STONES AND ROCKS found in different parts of our island have of late excited rather more than usual interest. At the meeting of the Royal Society of Edinburgh, at the beginning of January, Professor Simpson gave an account of his visit to the caves of Fife, and of the sculptures which were found rather abundant on the walls. These caves, or, as they were called in ancient Gaelic, *weems*, were so well known in mediæval times that they gave the name of Weems, or Wemys, to a district of Fife, which, in its turn, gave title to an earldom; and one of them at least served formerly as a church, and several of them are said to have been the residences of some of the early Scottish saints. Many of them are of large dimensions, some from eighty to a hundred feet in length, with proportionate height and breadth. The sides, or walls, are rudely sculptured with representations of various animals and combinations of lines, which are supposed to be emblems, though they may be merely fanciful diagrams. Among the animals figured on the walls of these caves are the elephant, the deer, the dog, the swan, the peacock, fishes, serpents, and monsters. Among representations of manufactured objects we find the mirror, the comb, the horse-shoe, etc. Professor Simpson called attention to the close resemblance between these figures in the caves and those on the sculptured monuments, of which so large a number have been published in Mr. Stuart's handsome volume, *The Sculptured Stones of Scotland*. In a former page we have stated our belief that the sculptures figured in this work belong to the Christian period of Scotland; probably not one of them is older than the sixth century after Christ. They bear a strong analogy to the rude designs in the older mediæval manuscripts.

Figures of animals were great favourites in these drawings, because from a very early period the Bestiaria, or popular treatises on natural history, usually accompanied with illuminations, were among the most popular of literary productions. This popularity might be explained by various reasons, into which it would hardly be in place here to enter. The figure of the elephant is curious, because some very ardent antiquarians have supposed that sculptures in which it appears belong to that extremely remote period when the elephant inhabited this country, and therefore long before it had become an island; but this is a supposition hardly deserving of our serious consideration. To trace the knowledge of the elephant in Britain would form a curious chapter of history. Polyænus, who wrote in Greek about the year 180 A.D., has handed down to us a popular anecdote of the manner in which Julius Cæsar made use of an elephant in forcing the passage of the Thames, in his second expedition into Britain (Polyænus, Stratagm., VIII. 23), which would imply that Cæsar brought elephants with him into this island. If this had been the case, that great general would hardly have omitted mentioning them in his Commentaries; but the elephant must have been sufficiently well known to the inhabitants

of Britain during the Roman period, and no doubt that knowledge, as far as it could be gained by figures and descriptions, was continued afterwards, or at least restored after the Christian period. We shall look forward with interest to the publication of Professor Simpson's account of his discoveries *in extenso*, and especially to what we hope will accompany it, illustrative engravings of the sculptures themselves.

The last part of a well-conducted local journal, *The Wiltshire Archæological and Natural History Magazine*, published under the direction of the Wiltshire Society, contains a peculiarly interesting notice of an incised marking on the impost of the GREAT TRILITHON AT STONEHENGE, by Dr. Thurnam—interesting as a warning to those who arrived at hasty conclusions in archæological questions, especially at this time, when the subject of excised marks and sculptures on stones and rocks is exciting so much attention. Some three or four years ago an inquisitive visitor to that still mysterious monument, Stonehenge, discovered on the great trilithon an inscribed figure, representing an object closely resembling a sickle, with the two Roman letters L V within the curved blade. It was moss-grown, and appeared to present all the evidences of antiquity. Much greater attention was drawn to this inscription in the visit to Stonehenge of a party of the British Association from the Bath meeting in September, 1864. Some declared it to be Roman, and it was suggested that it was the work of a Roman legionary, and that L V stood for *legio victrix*. Others believed it to be of still older date, and compared it with lapidary inscriptions found at Carthage, said to be Lybian, and with figures found in countries occupied by the Phœnicians. Our friend, Dr. O'Callaghan, with his good Irish quickness of perception, made the most probable suggestion of all, when, according to the newspaper reports, he suggested that, "after all, some Irish reaper may have cut the figure of his own sickle, and added the initial letters of his name (say Larry Varity), to record a visit made not many years ago."

Dr. Thurnam, following up the information given in a communication to a local paper immediately after this meeting, has succeeded in clearing up the whole mystery. It appears, from the evidence of a certain number of unexceptionable witnesses examined by him, that about the year 1827 or 1828, a man who appeared to be a mechanic, and who carried with him a basket of tools, was tramping by, and was seen to stop at this stone, and to take chisels, etc., from his basket, with which he deliberately cut the figure in question, and then continued his way to Salisbury!

Mr. Hodder M. Westropp, of Rookhurst, near Cork, has published, we believe for private distribution only, a series of plates of an interesting COLLECTION OF ANTIQUITIES, in his own possession. It is to be regretted that as yet the plates are accompanied with no explanatory text. A part of the objects represented are fibulæ—a very choice selection, ranging from the Roman period to the Anglo-Saxon, or Frankish, to the Dano-Irish, and to the later mediæval period. The most interesting of all, however, are a very remarkable series of the so-called "celts." They are named in the

plates "Etruscan celts"; but we are told that this denomination is only claimed for one specimen, and that, if we understand right, only because it was found at Perugia. All the others were found in the south of Italy, and, for anything we see, they are all probably to be considered as pure Roman. T. W.

PROGRESS OF INVENTION.

IMPERFECT COMBUSTION A SOURCE OF ACETYLENE.—It has long been known that acetylene is almost always one of the products, when organic compounds are subjected, for a long time to a red heat. But the experiments of M. Berthelot have shown that it is produced in other circumstances from organic, gaseous, vaporous, and liquid compounds; being due, in every such case, to imperfect combustion. Thus, when a gas, for instance, ethylene ($C_4 H_4$), is introduced into a tube closed at one end, and having within it a small quantity of ammonio-chloride of copper, and is then ignited, the tube being immediately after thrown into a horizontal position, and kept revolving between the fingers, so that the liquid may be diffused over the whole of its interior surface, a red compound of acetylene and copper will be formed. The experiment becomes yet more striking when a very volatile fluid, such as sulphuric ether, is used; the whole inner surface of the tube will then be covered instantaneously with a deep red opaque solid. It is not necessary to use a tube. If some ether is poured on a plate, and then ammonio-sulphate, the ether on being ignited forms acetylene, which covers the surface of the ammonio-sulphate with a coating of the red compound. The results of M. Berthelot's researches have led to the important conclusion that, during the combustion of a compound of carbon and hydrogen, it does not in all cases happen that it is the hydrogen which first combines with oxygen, the carbon being set free. The carbon may be the first to enter into combination; thus with naphthaline, during the combustion of which four of the constituent atoms of carbon are first united with oxygen. In reality, whether it is the hydrogen or the carbon that shall first enter into combination depends on the nature of the hydro-carbon; and the result is modified by the circumstance that the combustion is not completed at once, but by the successive decomposition of compounds formed one after another. When alcohol, for example, is burned, such a combustion takes place as forms aldehyde, which in its turn is decomposed, and new compounds produced, the formation of carbonic acid being one of the last links in the chain.

IMPROVEMENTS IN ELECTRO-METALLURGY.—The processes hitherto used in plating and gilding, etc., are not only more or less difficult, but extremely injurious to health; circumstances that induced M. Fred. Weil to make researches for the purpose of devising others not liable to similar objections. The result has been the important discovery that the coating of metals with other metals may be

effected merely by the use of alkaline solutions, in which precipitation of the oxides by the alkali is prevented by the presence of tartaric acid, glycerine, or some other harmless organic substance. This method is so effective that cast iron or steel may be coppered or bronzed by means of it with great facility; and brilliant and permanent colours may be imparted to the deposits which it forms. Ordinary temperatures generally suffice for it, and it never requires one which is much higher. The bright coating of zinc it produces on copper, or a metal which has been coated with copper, is less acted on by acids than ordinary zinc. It is extremely well adapted for the repairs of metallic coatings; as for this purpose, it is only necessary to form a kind of cup by surrounding the injured part with an elastic ring, etc., and place within it the metallic solution. Various modifications are required in the details, according to circumstances. Thus in coating with copper, a solution containing about 350 grammes crystallized sulphate of copper, 1·5 grammes sodio-potassic tartarate, and 800 grammes soda lime, containing about 55 per cent. free soda, in two gallons of distilled water is employed; certain precautions must be taken also for the purpose of keeping it at a uniform strength, and removing the dissolved zinc derived from the metallic zinc, which it is necessary to bring in contact with the article that is to be coated. To deposit copper from this, the articles, after having been extremely well cleaned, are suspended in it, but not so as to come into contact with each other, by means of zinc hooks, which are found to answer better than plates, and are left in it for a time which depends on the thickness of the coating, etc., desired. They are then lifted out of it, and again cleaned with great care. If stannate of soda, or a solution of bichloride of tin, previously treated with a sufficient quantity of soda, is added to the cupreous solutions before immersion and contact with the zinc, the deposit will be a real bronze. The copper solutions will answer for any metal whose oxide is insoluble in the fixed alkalies, except pure tin. When the latter is placed in contact with the zinc, it is oxidized, and the protoxide formed precipitates all the copper, in the form of red oxide. But either tin or lead may be deposited on copper, or on a metal which has been coated with that metal, by immersions in a strong solution of potash or soda, which contains a salt of tin or lead, and has been raised to the temperature of 100° Cent. If it is desired to prevent the tin from being associated with zinc, the alkaline solution and the metallic zinc must be placed in a porous vessel, which is to be immersed in a vessel containing the solutions of tin; and in the latter is suspended the article to be coated, which is connected by a wire with the zinc. When the alkaline fluid is saturated with oxide of zinc it may be freed from it by precipitation with sulphide of sodium. Alloys of copper and zinc, nickel and zinc, etc., may be deposited from tartro-alkaline solutions containing them on copper, or another metal which has been coated with copper, by contact with the zinc.

Dangers attending the Use of Nitro-Glycerine. — Nitro-glycerine has already to some extent superseded gunpowder and

gun-cotton in blasting, for mining purposes, on account of its convenience and great power; but late researches have shown that its employment is attended with very serious danger. It can indeed be heated to 50° Cent., or even exposed to the direct action of flame without explosion being produced; but simple agitation during transport may, on account of its great density, cause it to ignite. If kept at a temperature between 20° and 24° Cent., it gradually acquires a green tint, which continually augments in intensity, and small rhombic crystals of oxalic acid separate, their quantity becoming very considerable, and dense nitrous vapours being evolved if the vessel is left open. It solidifies at a temperature considerably higher than the freezing point of water; and the frozen particles are not less explosive than the fluid; even their friction against each other may cause them to ignite. These facts, for which we are indebted to M. P. Liebe, of Dresden, may perhaps explain some, at least, of the numerous explosions which occur from time to time with nitro-glycerine, without its being possible to assign any ordinary cause for them.

Application of Electricity to Sounding at Sea.—It is extremely difficult, even for the most experienced seaman, to determine the precise instant at which the lead of the sounding line touches the bottom; this arises chiefly from the great weight of the line at considerable depths, which causes the difference produced by support of the lead to be scarcely perceptible. M. Hédouin, of Lyons, has invented a sounding apparatus which is entirely free from this difficulty, and is not at all complicated nor hard to be managed. It consists of a line, within the whole length of which run two conducting wires, the upper ends of which are connected respectively with the poles of a galvanic battery placed in the ship. The lower ends are never connected, and consequently the circuit is never complete, until the lead touches the bottom: when this occurs, the lower portion of it, which partly slides up into the upper, presses a small piece of metal against the two lower ends of the wires. As long as the weight remains freely suspended, this connector, which is insulated and within a waterproof sheath, remains at a distance from the wires; on account of the lower part of the compound weight assuming the lowest position, with respect to the upper, of which it is capable. The instant the circuit is complete, a bell is rung by an ordinary electro-magnetic apparatus, and thus the attention of the sounder is drawn to the fact that the lead has touched the bottom. Besides this, a ratchet is by similar means thrown into action, and instantly arrests the descent of the line from the reel on which it is coiled; and thus even the attention of the sounder is rendered of comparatively little importance. If there is danger of the vessel getting into shallow water, or among sunken rocks, a sounding line of a given length suspended from the vessel, will give instant notice of danger when it occurs.

New mode of separating Cobalt from Nickel.—These two metals are separated from each other, in solutions containing them, with difficulty, and only by a complicated process; by a method which M. A. Terreil has lately discovered they are separated with

ease, even when the quantities are exceedingly minute; a circumstance of great importance in testing, or analysis. It consists in precipitating, and then redissolving, by the addition of ammonia in excess to the solution containing them, raising the temperature of the ammoniacal liquor, and adding to it just so much permanganate of potash as will impart to it a violet tint: then raising it to a boiling temperature, and after a few minutes redissolving by excess the oxide of manganese thrown down with hydrochloric acid. The clear solution being kept at a moderate temperature for a short time, and then left to itself for about twenty-four hours, all the cobalt precipitates as a red violet crystalline powder, the roseo-cobaltic hydrochlorate, which is to be thrown on a filter and washed, first with hydrochloric acid, next with a solution of sal-ammoniac, and lastly with alcohol; 100 parts of it, after desiccation, contains 22·7 of metallic cobalt. The alcohol having been driven off from the washings by heat, they are to be saturated with ammonia: after which a slight excess of permanganate of potash, or of an alkaline hypochlorite having been added to them, they are raised to the boiling point. This throws down all the manganese: and when the latter is separated by filtration, the solution contains only nickel.

A Simple Mode of Manufacturing Sulphuric Acid.—The necessity for large and costly leaden chambers has rendered the manufacture of sulphuric acid both troublesome and expensive. A method of producing it, in which the use of leaden chambers is dispensed with, not only greatly facilitates the process, but affords a product which possesses the important advantage of being altogether free from contamination by lead. Should it be found to answer for industrial purposes, it will constitute a very important improvement on the method so long in use. It consists in transmitting the acid fumes, formed in the ordinary way, through a series of earthenware cylinders, which are piled up and arranged in such a way as to form a number of columns, filled with coke, and communicating with one another. Steam is introduced into them as required; and the acid vapours being condensed by the coke, they trickle down into a reservoir placed beneath for the purpose of receiving them. The acid liquid thus obtained is concentrated in the usual way.

Aniline Black.—The discovery of a fine black, produced from aniline, may almost be considered as completing the series of magnificent colours obtained from that substance. This new dye is the more valuable since it may be associated with any kind of madder colour, and may be treated in subsequent processes like logwood. It is obtained by dissolving hydrochlorate of aniline in an aqueous solution of hydrofluosilicic acid (spec. grav. 8° B), which has been properly thickened, and then adding chlorate of potash, and printing, or preparing the tissue with chlorate of potash and afterwards printing. On raising the temperature from 32° to 35° Cent., a beautiful and permanent black is produced. The hydrofluosilicic acid required may be obtained by decomposing a mixture of fluor spar and sand with sulphuric acid. The decomposition which takes place during the process consist in decomposition of the

chlorate by the hydrofluosilicic acid, silicate of potash being formed, and chloric acid being set free. A part of this chloric acid acts on the hydrochloric acid of the hydrochlorate of aniline, forming a mixture consisting of free chlorine and intermediate oxygen acids of chlorine; and the remainder unites with this mixture forming the black dye. That such are the changes which occur, has been established by simple and very conclusive experiments.

Miscellaneous.—*Ancient Stained Glass.*—It has been found that the colours of ancient stained glass may be completely restored by leaving it immersed for several days in a solution of carbonate of soda, which dissolves away the organic matter to which in part the dimness produced by age is due, and then immersing it for several hours in dilute muriatic acid to remove the mineral substances, which also impaired the brilliancy of the colours.——*Tanning by means of Sulphate of Iron.*—Instead of a liquid containing tannin, M. F. Pfanhausen uses that obtained by heating to redness sulphate of iron, which is kept constantly stirred, dissolving the residue in water, allowing the solution to rest, and then pouring off the clear portion. Weak solutions are employed at first; and the process of tanning is complete in a very few days. The leather thus obtained may answer well for many purposes.——*Complementary Colours.*—The production, by M. Niepce de Saint-Victor, of black, in photography, by means of complementary colours, has given rise to researches on the subject by M. Chevreul: who found that, although complementary radiations of the spectrum produce *white*, those radiations which emanate from complementary colouring matters, applied in succession, or simultaneously to the cloth, etc., afford, according to the accuracy of the proportions, *black*, *brown*, or *grey*. Thus a blue pattern printed on orange will appear black. This subject, when fully developed, may have a most important bearing on arts and manufactures.——*Interesting Galvanic Experiment.*—If an electro-magnet is excited by a rather powerful galvanic battery, metallic filings constituting a portion of the electric current, when one of the conducting wires is raised out of the filings, it will draw after it a continuous chain of particles; and in this way, if moderate care is used, all the filings may be formed into a kind of metallic thread. The effect is due, most probably, to the particles being soldered together by the high temperature which the sparks that are seen constantly passing from particle to particle of the filings produce. It cannot be ascribed to magnetism, since it is produced even when the filings consist of silver, copper, or other metals incapable of being made to exhibit ordinary magnetism.——*Very High Temperatures Produced by Gas.*—There is no reason why the very highest temperatures should not be produced by the combustion of gas; and in reality it has been found that by regulating the supply of air and gas, and preventing the caloric evolved from being dissipated, a very great heat may be obtained. For this purpose it is only necessary to combine a number of flames produced by Bunsen burners, but without permitting them to completely penetrate one another, and causing a draught by means of a sheet

iron tube about two metres high; the heat, by a proper management of the flame, and by the products of combustion being made to act on both sides of the refractory envelope within which the substance to be operated on is placed, becomes extremely powerful. With such an arrangement it was found that two square metres of gas, burned under a pressure of five or six centimetres of water, fused 670 grammes of silver in fifteen minutes; and 500 grammes of very infusible cast iron in thirty minutes.——*Protection of Iron.*—It has been ascertained that sheet iron may be protected from oxidation by coating it with a thin fused layer of magnetic oxide. For this purpose it is embedded in hymatite, or some other native oxide of iron, reduced to a fine powder and kept for several hours at a red heat, and is then allowed to cool gradually. The black coating produced in the same way by a combination of the oxides of zinc and iron is probably still more effective. It may be found very advantageous to cover in this way the iron used in shipbuilding.

LITERARY NOTICES.

Sea-Side Studies in Natural History. By Elizabeth C. Agassiz and Alexander Agassiz. Marine Animals of Massachusetts Bay. Radiates. (Boston, Ticknor; London, Trübner & Co.)—Although much of the scientific knowledge which has been accumulated concerning marine animals, is the result of the labours of foreign naturalists, not only have our own observers contributed their full share, but they have succeeded in rendering their pursuits more extensively popular in this country than it has become in any other. We believe the present work is the first important effort to make marine zoology popular in America, and especially in Massachusetts Bay. It is elegantly got up, with numerous illustrations, and will interest many readers in this country, as a considerable part of the subject matter is equally appropriate to either side of the Atlantic. From these pages we gather that Massachusetts Bay is less rich than our own coasts in compound polyps, polyzoa, and certain other forms, but remarkably well off in jelly-fishes and star-fishes. The chapters devoted to the embryology of the radiata are very well written, and the explanations thus afforded and illustrated by engravings, will render an important amount of scientific information accessible to the general reader. Although the shores of Massachusetts Bay are the chief localities mentioned, some of the objects described belong to other regions, as, for example, the millepore of Florida, a very curious coral, which has been recently shown to belong the acalephs, or jelly-fishes. As the writer of this work says, "in the whole history of metamorphosis, that wonderful chapter in the life of animals, there is nothing more strange or more interesting than the transformation of the acalephs. First as little floating planulæ, or transparent spheres, covered with fine vibratile cilia, by

means of which they move with great rapidity, then as communities fixed to the ground and increasing by budding like corals, or multiplying by self division, and later as free swimming jelly-fishes, many of them pass through phases that have long baffled the investigations of naturalists." Our own coasts afford excellent opportunities for studying these questions, many of which have been noticed in former numbers, and others will form the subject of future papers in due course. The discovery of the true character of the millepore carries back the history of the acalephs or jelly-fishes to geological periods, as many fossils supposed to be true corals will in future be referred to that group. The writers say that while polyps and star-fishes live for many years, the existence of the acaleph with all its changes is comprised within one year. This may be generally true, but it is not so always, as some successful aquariums, like that of Mr. Drabble have shown. In vol. iv. p. 149, will be found, as our readers know, an exquisite coloured plate of a Blue Cyanæa captured by Mr. Pope at Torquay. To that article we must refer for a description of this interesting genus, of which the American shores exhibit splendid specimens. One of these, the Cyanæa arctica is figured in the work before us, and if the creature could be seen in a large transparent tank it would be a most gorgeous spectacle. A large one was found on rough measurement to be seven feet in diameter, with tentacles stretching behind him "to the extent of some hundred and twelve feet." "This sounds so marvellous," says the writer, "that it may be taken as an exaggeration; yet the facts are rather understated than overstated in the dimensions given." It may well be imagined "that it is no pleasant thing when swimming or bathing to become entangled in this forest of tentacles," which sting like nettles from their innumerable lasso cells. The hydroid producing this gigantic jelly-fish is "not more than half an inch in height when full grown." Amongst the very interesting creatures described and figured is the Nanonia, a fine swimming hydroid, the history of which is highly curious. When first found, it consists of a single hydra, with an oil bubble at one end which serves as a float. It is then nothing but a floating stomach. Buds soon spring from it, which develope in different manners into locomotive organs or swimming bells. These act by alternately contracting and expanding, taking in and throwing out water, and thus generating currents that cause the whole community to move. "Besides these locomotive members, the community contains three kinds of hydræ arising as buds from the primitive hydra below the swimming bells. The latter always remaining nearest the oil bubble at the top, while the first hydra is gradually pushed downwards and remains at the end of the string. The first set of hydræ are open-mouthed, and their function is to feed the family. The second are also open-mouthed, and feeders differing from the first by having their tentacles coiled in an elegant cork-screw spiral. The third set of hydræ have closed mouths, and their function is unknown, but they are supposed to drop from the parent stock and found new colonies. In addition to the members already mentioned of this curious floating commuuity are reproductive individuals.

This beautiful compound creature is small; the stem being "about three inches long, though the tentacles hanging from the various members, give an appearance of greater length." The chapters on the star-fishes and their neighbours, are very well written, and amongst many other illustrations is a fine plate of the splendid "Basket Fish," *Astrophyton Agassizii*.

The Treasury of Botany: a Popular Dictionary of the Vegetable Kingdom, with which is incorporated a Glossary of Botanical Terms. Edited by John Lindley, Ph.D., F.R.S., F.L.S., late Emeritus Professor of Botany in University College, London, Author of the "Vegetable Kingdom," and Thomas Moore, F.L.S., Curator of the Chelsea Botanic Garden, and Co-editor of the "Gardener's Chronicle." In two Parts. (Longmans.)—The best way to test the value of a dictionary is to keep it for some time, turn to it whenever an opportunity for reference occurs. We have tried the *Treasury of Botany* in this way, looking for such objects as we have found contained in various works of travels, or to which our attention has been otherwise called. The result has been highly satisfactory, and has given us a very favourable impression of the skill with which the various articles have been collected and compiled. This work makes two small but stout and handsome volumes, richly illustrated with remarkably good woodcuts, and containing, moreover, twenty highly finished plates of botanical landscapes in various parts of the globe. The articles exhibit a judicious mean between dry technicality and the too commom attempt to be over popular. They will be much valued in families possessing gardens and greenhouses, or reading books of travels, in which allusions to plants and vegetation are frequently made. The *Treasury of Botany* is one of the most satisfactory works of reference we have seen for some time.

Catalogue of Works on the Microscope, and of those referring to Microscopical Subjects in the Library of Freeman C. S. Roper, F.L.S., F.G.S., F.Z.S., Hon. Sec. Mic. Soc. London, Hon. Mem. Mic. Soc. Edin. Printed for private circulation, by J. E. Adlard.—Mr. Roper having a fine collection of microscopic works, the catalogue which he has just printed is a valuable list for the student to refer to. As it is a book calculated to save microscopists a great deal of trouble in ascertaining what has already been accomplished, we should have advised its being published in the ordinary way. The thanks of all microscopists are due to Mr. Roper for the pains he has taken in this useful work.

The Geological Magazine, Vol. III., Nos. 1 and 2, or Monthly Journal of Geology, with which is incorporated the Geologist. Edited by Henry Woodward, F.G.S., F.Z.S., of the British Museum, assisted by Professor John Morris, F.G.S., etc., etc., of University College, and Robert Etheridge, F.R.S.E., F.G.S., of the Museum of Practical Geology. (Trübner.)—The *Geological Magazine* has lately passed into the enterprising hands of Messrs. Trübner & Co., and it is so well managed that it deserves success. The first of the new series contains a valuable paper by Mr. Woodward on a new fossil crustacean from Lyme Regis, the *Æger Mardii*, of which a

plate is given; and the second number has a figure and description by Professor Owen of a new sauroid fish from the Kimmeridge clay. Other papers in the first number relate to "New Coral Reptiles," by Mr. Etheridge; "The Raised Beach of Cantire," by Mr. Hull; and "The Cretaceous Rocks of the South of England," by Mr. Meyer. In the second number, Mr. Binney treats of the "So-called Lower New Red Sandstone of Central Yorkshire;" Mr. Searles Wood on "The Thames Valley;" and Mr. Mackintosh on the "Sea *versus* Rain and Frost." There are also various reports and correspondence.

THE HOUSEHOLD: a Magazine of Domestic Economy and Home Enjoyment. Nos. 1 and 2. (Groombridge & Sons.)—Under this excellent title, Messrs. Groombridge have produced a cheap and interesting family magazine. The articles comprise a variety of subjects belonging to the management of a household, together with a new story by the author of "A Trap to Catch a Sunbeam," known wherever English is read as one of the most elegant little tales of modern times. The editors have provided matter for all tastes, from popular scientific papers to "Cheap Cookery for Hard Times." The tone of the articles is remarkably healthy. They are simple without degenerating into twaddle, and vigorous without those spasmodic efforts that offend good taste. Every family may obtain useful hints from them, and they will be found to contain a good proportion of amusing matter.

CONTRIBUTIONS TO NATURAL HISTORY, chiefly in relation to the Food of the People. By a Rural D.D. (Blackwood & Sons.) —A set of pleasantly written, gossiping papers from various periodicals, to which their author has contributed, ranging from hippophagy to salmon-culture, muscles, and popular weather prognostics.

THE ANTHROPOLOGICAL REVIEW, AND POPULAR MAGAZINE OF ANTHROPOLOGY. (Trübner.)—A paper on the comparative anthropology of England, by D. Mackintosh, F.G.S., possesses a considerable amount of interest, though the writer is open to the charge of riding his hobby a little too fast. A plate is given of skulls of the Coraline Islanders; Wright's excellent paper on bronze weapons demolishing the stone, bronze, and iron epoch theory, is reprinted; and Dr. Charnock treats of the origin of Gipsies. The *Popular Magazine of Anthropology*, printed with the *Anthropological Review*, and likewise published separately, is, in its present condition, a mistake. To suppose that any science can be made popular by dispensing it at the rate of forty-eight pages for a shilling, indicates that the concoctors of such a scheme must themselves be anthropological curiosities; and the wonder at their strange notion is increased when the quality of the material offered at this high price is considered. A great deal of it is borrowed from other sources, and not a single paper possesses the average merit of magazine articles. While noticing the publications of the Anthropological Society, we cannot refrain from adverting to the vulgar, sensational character of its proceedings. Any virulent abuse of negroes or missionaries, any

rabid nonsense tending to stimulate hatred and violence towards the African races, or to promote admiration of their oppressors, appears to be taken for science by the gentlemen who manage this peculiar association. "A Night with the Anthropologicals" is now expected to provide the sort of entertainment offered by a low-class debating club, and all the dignity and decency of true science is made to give way to declamation as ungentlemanly as it is absurd.

OUT WEST: A Series of Letters from Canada and the United States. By GEORGE TUTHILL BARRETT, M.A., Fellow of King's College, Cambridge. (Groombridge & Sons.)—English people are never tired of reading or writing books about America. The present volume is an agreeably written narrative of a pleasure trip. It is evident that the writer left his own country with a respectable allowance of those prejudices which are fashionable amongst the upper section of the middle class, and that he honestly and manfully abandoned them as he became acquainted with evidence of their untruth. Mr. Barrett had an interview with President Lincoln, and another with Mr. Seward. Of the former he speaks in genial terms. Boston pleased him exceedingly, and he was surprised to find what we may term the more civilized life of America much better than those portions of it which ordinary travellers exclusively see. Had Mr. Barrett seen more of the domestic manners of the New England States, his opinions would have undergone still further modification.

CASTAWAY ON THE AUCKLAND ISLES: A Narrative of the Wreck of the "Grafton," and of the Escape of the Crew after Twenty Months' Suffering. From the Private Journals of CAPTAIN THOMAS MUSGROVE; together with some Account of the Aucklands. Edited by JOHN SHILLINGLAW, F.R.G.S. (Lockwood & Co.)—A genuine narrative of a sailor's shipwreck on an uninhabited island is sure to be interesting; and in the present case the reader has, in the extracts from Captain Musgrove's journal, which were written in seal's blood, a veritable transcript of his doings and feelings from day to day. In this case there was little of the Robinson Crusoe spirit, as the worthy Captain was in natural and constant anxiety about his wife and family; and every moment his thoughts wandered wistfully towards that home which he feared he might never see. As long as fresh birds and seal-flesh could be obtained, the shipwrecked party did tolerably well in point of food. They built themselves a house, and one of them, Mr. Raynal, the mate, had quite a genius for doing smith's work under difficulties. When severe weather came, and seals were scarce, the commissariat was rather miserable; and the whole party were heartily glad when they had contrived to repair one of the ship's boats, and made their escape. Although in some respects it was a case of shipwreck made easy, there was little to recommend it to the lovers of romantic adventure; and no young gentleman who peruses the narrative is likely to be incited to leave home in search of such a fate. In one of the appendices is an account of the "sea lion," and the following interesting account is given of the way in which Mrs. Sea Lion manages her family:—"It

might be supposed that these animals, even when young, would readily go into the water, that being one of their natural instincts; but, strange to say, such is not the case; it is only with the greatest difficulty, and a wonderful display of patience, that the mother succeeds in getting her young in for the first time. I have known a cow to be three days in getting her calf down half a mile and into the water; and what is most surprising of all, it cannot swim when it is in the water. This is the most amusing fact—the mother gets it on her back, and swims along very gently on the top of the water; but the poor little thing is floating all the time, and continually falling from its slippery position, when it will splutter about in the water precisely like a little boy who gets beyond his depth, and cannot swim. Then the mother gets underneath it, and it again gets on her back. Thus they go on, the mother frequently giving an angry bellow, the young one constantly bleating and crying, frequently falling off, spluttering, and getting on again, very often getting a slap from the flipper of its mother, and very often she gives it a very cruel bite." Notwithstanding this severity of maternal discipline, the sea lioness is very fond of her young, after her own fashion.

Proceedings and Transactions of the Nova Scotian Institute of Natural Science of Halifax, Nova Scotia. Part III.—The papers in this publication evince a degree of mental activity that we are afraid few of our colonies could equal. Dr. Gilpin discourses on the Mammals of Nova Scotia, Captain Hardy has a paper on Provincial Acclimatization, and Professor Lawson endeavours to show that the heather (*Calluna vulgaris*) is a genuine native of the province of Nova Scotia. He was told he should find it at St. Ann's, and he says—"On reaching that place I found the *Calluna* was growing in a bit of boggy land, among stumps of spruce trees, on an uncleared part of Ulston farm, belonging to John Robertson, Esq., President of the St. Ann's Agricultural Society, who proceeded with me to the spot, and informed me that he had known the plant to have existed there for about ten years. It was originally noticed by a Highlander when mowing, who immediately ran to his master, exclaiming, 'I have found heather!'" Professor Lawson expressed his belief that the plant was a genuine native. Other papers relate to the Reptilia of Nova Scotia, reported on by Mr. Jones, and its Economic Mineralogy, by Dr. How.

SCIENTIFIC SOCIETIES.

BY W. B. TEGETMEIER.

During the past month the scientific meetings have not been distinguished by the announcements of any new discoveries, nor have many papers of extreme interest been read or discussed. The Anthropological Society had a special meeting at St. James's Hall, to hear a paper by Captain Pim on "The Negro," but the subject was treated

with reference to recent events in Jamaica rather than from a strictly scientific point of view. The minds of men are far too much affected by party feeling at the present time to render possible the calm and philosophic discussion of matters relative to the negro.

The nature of the Eozoön was discussed at the Geological Society, a paper from Professor King and Dr. Rowney being read, in which the authors stated that Eozoönal Serpentine consisted essentially of variously formed granules of chrysolite, or some other allied mineral, bedded in or intermixed with calcite. Although differing in some respects from the typical form as seen in the Greville Rock, the varieties of Serpentine which they have examined from Connemara, Donegal, the Isle of Skye, India, Bavaria, and the State of Delaware, are considered as belonging to the same section. The Serpentine from Cornwall, the Isle of Anglesea, and Saxony, which appears to be devoid of Eozoönal structure, they were disposed to look upon, but with considerable doubt, as an eruptive rock. The authors stated their conviction that every one of the presumed organic structures of Eozoönal Serpentine is purely and primarily mineral or crystalline. The "skeleton" they held to be identical with the calcareous matrix of certain minerals, notably chondrodite, pargasite, etc. They adduced various considerations to show that the "proper wall" cannot have resulted from pseudopodial tubulation. The dendritic and other forms, considered to represent the "canal system," were shown to be tufts of metaxite, or some other allied variety of chrysolite; and in their opinion they are no more than embedded "imitative" crystallizations. What have been taken for "stolons," they were convinced are for the most part crystals of pyrosclerite. The "chamber casts" were considered to be identically represented among both minerals and rocks—in the former by the grains of chondrodite, pyrallolite, pargasite, etc.; and in the latter by the segmented kernels of native copper, zeolites, etc., in eruptive rocks; also by the remarkable botryoidal and other shapes which occur in the Permian limestone of Durham. The authors concluded by offering it as their opinion that Eozoönal Serpentine is a metamorphic rock; and they threw out the suggestion that it may in many cases have also undergone a pseudomorphic change.

On the same evening Dr. W. B. Carpenter read a paper on "The Structure and Affinities of *Eozoön Canadense*," in which he stated that a recent siliceous cast of *Amphistegina* from the Australian coast exhibited a perfect representation of the "asbestiform layer," which was fully described in his article on the structure of Eozoön in the INTELLECTUAL OBSERVER, and which led him to infer the nummuline affinities of that ancient foraminifer—a determination which has since been confirmed by Dr. Dawson. This "asbestiform layer" was then shown to exhibit in Eozoön a series of remarkable variations, which can be closely paralleled by those which exist in the course of the tubuli in the shells of existing nummuline formanifera, and to be associated with a structure exactly similar to the lacunar spaces intervening between the outside of the proper walls of the

chambers and the intermediate skeleton, by which they become overgrown, formerly inferred by the author to exist in *Calcarina*.

Dr. Carpenter then combated the opinion advanced by Professor King and Dr. Rowney in the preceding paper, and stated that even if the remarkable dendritic passages hollowed out in the calcareous layers, and the arrangements of the minerals in the Eozoic limestone, could be accounted for by inorganic agencies, there still remains the nummuline structure of the chamber walls, to which, the author asserts, no parallel can be shown in any undoubted mineral product.

In conclusion, he stated that he had recently detected Eozoön in a specimen of ophicalcite from Bohemia, in a specimen of gneiss from near Moldau, and in a specimen of serpentinous limestone sent to Sir Charles Lyell by Dr Gumbel of Bavaria.

Among the members of the Royal Geographical Society much anxiety has been excited respecting the fate of the gallant explorers, Baron von der Decken and his party. Science has its martyrs as well as religion; and of the sciences which have contributed members to this noble army, geography has been by no means behind-hand. Mysterious Africa, attacked on all sides by brave men who will to wrest her secrets from her, has found means to defend step by step almost every foot of her newly explored soil. Even if death has not awaited the adventurers, they have often met with disease in painful forms—with opposition from native tribes—even at times with more or less prolonged captivity. Baron von der Decken, at his own expense, had fitted up two vessels with which to sail up the river Juba, one of those great East African streams of which as yet so little is known. The embouchure of the Juba is only about thirteen miles south of the equator. In attempting to cross the bar at the mouth of the river, the Baron lost the smaller of his two vessels. Farther up the stream, the larger one ran aground on a sand-bank, and had to be left. All that was possible to be removed was taken out of her, and the party encamped on the bank of the river. The Baron, with a companion, went to seek aid from the natives, with a number of whom there had before been some slight dispute. He did not return, and the remainder of his party were attacked by a crowd of natives, who killed some of the Europeans and wounded others. Lieutenant von Shickh, who was left in command, considered his position as no longer tenable, and so made the best of his way back to Zanzibar with those of the party who remained.

The fate of the Baron is a matter of doubt and painful surmise. He is supposed to have fallen into the hands of some of the Somauli tribes; and if this is the case, we are assured by Colonels Rigby and Playfair, H.B.M.'s late and present Consuls at Zanzibar, that there is ground of hope for his life. The Somauli are fond of retaining Europeans as captives, but, so far as is known, do not put to death those who fall into their hands. This opinion has been confirmed in a letter addressed to one of the daily papers by a former resident in Eastern Africa, who has had considerable intercourse with the Somauli. It is greatly to be hoped that these anticipations may prove correct. It will be recollected that Baron von der Decken has

already done good service to geography in undertaking the exploration of Mount Kilimandjáro, and that he received the Founder's Gold Medal of the Royal Geographical Society for his intrepid and successful journey.

NOTES AND MEMORANDA.

Spectrum of Tempel's Comet.—The following letter addressed by Padre Secchi to the editor of the *Giornale di Roma* will be read with interest in connection with the observations of Mr. Huggins, given in our last number. We are indebted to Mr. Freeman for sending us the translation :—

"Rome, *9th Jan.*, 1866.

"Permit me to communicate to you the result of an important observation made yesterday evening on Tempel's comet. Examining the light of this object with the spectroscope, I found that its spectrum was very peculiar. It was composed of three principal lines projected on a very faintly-shaded ground. The chief of these three lines is pretty bright, and occupies a space as broad as that of group 6 of Fraunhofer. It is susceptible of measurement, and its position corresponded with the green colour towards the middle, and precisely at two-fifths of the interval which separates the group 6 from the line F in the spectrum of Fraunhofer, reckoning from 6 towards F. The other two lines are extremely faint, and it was impossible to fix their position, as much owing to the faintness of the comet as to the clouds which rose from the horizon. One of these is very near to the greater one, and is distant from it towards the red but little more than the breadth of the principal line, the other is towards the violet, at some distance. If the comet increases in brightness every endeavour will be made to determine its exact position. Besides the above-mentioned lines, there is, as it were, a general roundness slightly diffused, such as the spectrum would be of a star of the 8 or 9 mag., which is, perhaps, the little nucleus which the comet itself shows.

"The nature of this spectrum of the comet is quite different from that of planets, and of the solar light reflected from them, it is indeed different from that of the stars, and is analogous only to that of nebulæ, which, as is known, are of monochromatic light. But the tint of this light of the comet is different from that of the nebulæ, and is separated from it by more than all its breadth, as is verified in the nebulæ of Orion. Many other nebulæ of irregular form, examined during the past summer, showed their light to be analogous to that of Orion.

"The actual comet, however, belongs to the nebulous category by its monochromatism ; it approaches it in similarity in having also its light green, but it is manifestly of different refrangibility.

"It is known that this monochromatic condition of the light of the nebulæ is attributable to a molecular constitution different from that which forms the planets and stars ; hence, also, this comet would have the same structure. It is commonly believed that the structure of the nebulæ is that of matter in a state of extreme tenuity, and almost atomic, the same may be said of this comet.

"We are not able to say whether this is a property of all comets, owing to the want of data, and it can only be determined after the examination of many of these bodies. But from this sole fact, it already appears that astronomers have, with reason, expected from spectroscopic researches the solution of many problems of celestial physics. From such observations, it would appear that not all the light which comes from the comet is reflected from the sun, or if it is so, that it suffers a singular amount of absorption.

"It is not improbable that the faint diffused light which forms the ground of the spectrum is due to the light reflected from the sun, and that the residue is the light itself of the comet.

"For further studies the solution is reserved of these questions, the existence of which we can at present only point out.—I have the honour, etc.,

"P. A. Secchi."

Auroral Arches, 7th Feb.—Mr. Alexander Herschel describes a fine auroral arch seen by him at Bagshot, at 6h. 52m. P.M. It had the appearance of a brilliant bow of silvery white light 3° or 4° in width, and bent like a flat arch towards the horizon, spanning the N.W. horizon at an altitude of only a few degrees. At 6h. 55m. the arch resolved itself into tall vertical streamers of moving light, and a few minutes later disappeared. Mr. T. O. Barker, writing from Newcastle-on-Tyne, says that on the same evening auroral arches and radiations were visible from 7 to 9. At 7·15 he saw a well-defined and distinct arch about 9° wide, extending from E. to W. It passed over Cygnus, the northern extremity of Ursa Minor, and the northern end of Ursa Major. Stars were distinctly visible through it. Coruscations of auroral light at the same time emanated from a width of about 40° of the northern horizon, and rose to the zenith when they culminated in a point, crossing Polaris in their course, and passing through or under the luminous arch.

Biela's Comet.—This comet does not appear to have been found as reported. In the *Astr. Nachr.*, 1571, Father Secchi states that all hope of finding it has vanished, but in the search he met with several faint nebula not down in Sir J. Herschel's catalogue.

The Orion Nebula.—Father Secchi states the nebulous matter is prolonged from 49 and υ to ζ of this constellation.

Trichina Spiralis.—We have received from Mr. Collins a beautifully-prepared slide of this curious parasite, which has recently occasioned so many deaths in Germany. The slide in question contains a thin and very small slice of pork, in which are a multitude of cells, with the worm-like Trichina coiled up in them. The history of this parasite will be found in Dr. Cobbold's *Entozoa*. The practice of eating raw and partially-cooked pork is very favourable to the introduction of these creatures in the human organism.

Supplementary Eyes in a Fish.—Professor Leuckart considers that certain brilliant spots grouped with more or less regularity on certain Scopelinide fish, and particularly on the *Chauliodus Sloanii*, are accessory eyes. The existence of more than a thousand such eyes in a vertebrate animal is quite unexpected. They are distributed over the hyoid and its dependencies, on the head and on the belly, where they form two parallel rows. Professor Leuckart's opinion is based on the anatomical structure of the organs, which have the form of little cylinders, with the anterior part occupied by a spherical body like a crystalline lens, behind which is a sort of vitreous body. No more has yet been detected, but the specimens examined have not been fresh. Similar appearances are found in the genus Stornias.—*Archives des Sciences*, 97. *Bericht über die versam. der Deutsch Naturrf. u. Aerzte*, 1865.

Amazonian Fishes.—M. Milne Edwards has read a letter from M. Agassiz, stating that he has tripled the number of species of fish known to exist in the Amazon and its affluents. He has discovered many new forms and fresh facts, such as the hatching of their eggs by several fishes of the Chromide family. This performance takes place in the pharyngeal portion of the facial cavity.—*Comptes Rendus.*

New Polarizing Prisms.—MM. Hartnack and Prazmowski recommend deviating from the form of the Nichol prisms. The shape they recommend is shorter, and has both ends normal to the incident and emergent rays. According to the cementing substance employed they give the following angles:—With Canada balsam, refracting index 1549, the faces of the Iceland spar make with the plane of section an angle of 79°; with balsam of copaiba, index refr. 1507, the angle is 76°·5; with linseed oil, index refr. 1485, the angle is 73°·5; rich poppy oil, index refr. 1463, 71°·1. The two middle ones give the largest angle of the field—namely, 35°.

ENGRAVING ON GLASS.—MM. Tessié du Mothay and C. R. Maréchal describe their mode of engraving on glass so as to produce a dull surface (*mat*). They observe that a solution of hydrofluoric acid in water produces bright etching lines on glass, as it dissolves everything it meets, while the gaseous hydrofluoric acid makes dull bites in the glass. For etching on glass or crystal they recommend a solution of 250 grammes of fluoride of potassium, well crystallized, in 1000 grammes of water, and 250 grammes of hydrochloric acid; and then, to render the fluorides of lead and lime less soluble, they add about 140 grammes of sulphate of potash, or instead of the last-named salt, sulphate of ammonia, or oxalate of potash, or some chloride, like that of zinc, which has a strong affinity for water.

PHOTOGRAPHIC REST.—Mr. How has shown to us the Patent Universal Rest devised by Mr. Sarony, of Scarborough. It is a very ingenious invention, providing a comfortable support for photographic patients of all sizes and in all positions. The instrument admits of most diversified positions, and where the back of a person having a portrait taken is supported by it, it is easy to keep all the body and the head steady without the annoyance of the ordinary head rest.

SUN SPOTS.—M. Faye sums up a paper in *Comptes Rendus* (No. 25, 1865), by saying that "sun spots are not due to protuberances or clouds above the photosphere, nor can they be likened to superficial scoriæ; but they are openings accidentally made in a luminous envelope, the thickness of which appears to be composed with from 900 to 1600 leagues. Many irregularities, in appearance capricious, long observed by astronomers, and ascribed to a gyration analogous to that of water-spouts and cyclones, whether from a spontaneous tendency of spots to recede from one another, or from the material influence of adjacent spots, may be explained simply by a new irregularity in continuous variation of motion in different parallels. M. Faye adds that the regularity in spot movements appears incompatible with any hypothesis that makes the photosphere in absolute dependance on currents engendered otherwise than in the interior of the sun's mass. "The progressive retardation of the rotation of the photosphere as the poles are approached, is so regular, that we could not perceive in it the effects of cyclones confined to so limited an area as the external atmosphere."

SIZE OF STAR DISCS.—*Monthly Notices*, December 8, contains a Paper by E. J. Stone, Esq., "On the Telescopic Discs of Stars," in which he says, "theory informs us that if a pencil of homogenous light diverge from one point, and after refraction through a lens, with a circular aperture, converge accurately to a focus, then instead of a single point of light at the focus, we shall have a small disc of light, the intensity of the illumination of which rapidly degrades to a ring of absolute blackness, then increases to a ring of maximum illumination, then decreases to a ring of absolute blackness, and so on for many alternations; the illumination, however, at the different maximum degrades with such rapidity, that at the first, second, and third maximum we have respectively $\frac{1}{17}$th, $\frac{1}{112}$th, and $\frac{1}{312}$th of the illumination at the centre of the disc." Mr. Stone also says, "If we should attempt to compare the measures of star discs of different apertures, theory would not necessarily require these measures to be in the exact inverse ratio of the radii of the apertures. It would, however, require that any diminution of brightness in the image, any increase of magnifying power applied to the telescope, should be followed by a tendency in the measures to come out smaller." Mr. Stone gives a table of the theoretical degradation in the brightness of the central disc. The light at the centre is taken as an unit, and the angular distance from the centre to the first black ring is divided into twenty parts. This table shows that for some considerable distance from the black ring the intensity of the light is exceedingly feeble as compared with the centre. At the 9th of these divisions it is about one-half, and at the 17th, about one quarter. If the visible disc always extended sensibly to the first ring, the size of star discs in telescopes would vary inversely as the radius of the aperture, "but this certainly is not true, for if so the apparent disc of a faint star would be as great under the same circumstances of vision as that of a bright star." Mr. Pritchard asked Mr. Stone whether "if the spherical aberration in one telescope were better corrected than in another, it would, *ceteris paribus*, have a tendency to reduce the size." Mr. Stone replied in the affirmative.

Mr. Pritchard then expressed the very rash opinion that "a telescope possessing an amount of spherical aberration that would interfere with the diameter of the disc, would be such a telescope as no honest man would venture to sell, and no skilful man would trouble himself to use."

Mr. Dancer on Opaque Illumination.—At the Manchester Philosophical Society, Mr. Dancer exhibited on the 28th of November, a mode of illuminating opaque objects under high powers, the same as that devised by Mr. Smith, and shown by Mr. Ross—namely, placing a small mirror so as to throw light down one tube of a binocular instrument. Another contrivance recommended by Mr. Dancer, is a small mirror ⅛th of an inch in diameter, inserted 2½ inches above the objective, and receiving light through an opening in the side of the tube. This is merely a modification of Prof. Smith's plan, and without the diaphragms which make the latter more complete.

Warm Winters.—M. de Fouvielle observes in *Cosmos* that, "the present season is not so exceptional, as many persons unacquainted with meteorological history may suppose. Among the months of December and January, which may rival those which have just elapsed, we may cite those of 1822 and 1824. Still further back in history, we find January 584, famous for the roses which the subjects of Frédégonde gathered in the fields round Paris. The year 1829, when Charles of Anjou ascended the throne of Sicily, also afforded roses and violets during its winter. Chroniclers report that the winter of 1420 was so mild, that cherries were ripe in August, and grapes in May. If we may believe what they say of 1585, that year was not less favoured, as corn was in the ear at Easter." He also mentions the year 1719, as one in which most trees flowered in the early months; but then frosts came on in March and April.

Celestial Photography.—In the Photographic Section of the Philosophica Society of Manchester, Mr. Brothers read an interesting paper on this subject, on the 15th December. He uses a very simple mode of attaching the plate-holder to the eye-piece, by a piece of sliding brass tube. He gives a sketch of the apparatus, and the paper, as printed, is accompanied by a view of the moon from a negative of Mr. Rutherford, taken with a refractor 11¼ inches aperture, and corrected for the chemical ray.